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CONTENTS

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THE RESEARCH PICTURE ON POTATOES AT THE USDA's EASTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION[1]

R. H. Treadway, C. F. Woodward, and N. E. Roberts[2]

Of the fruits and vegetables that are among the commodities assigned for study to the Eastern Utilization Research and Development Division (Fig. 1), one of the most important is potatoes. The potato is important both nutritionally and economically. Its position as a staple in the American diet makes maintenance of its wholesomeness and food value vital to the health of our people. Economically, the potato industry is a multi-million-dollar agricultural enterprise that reaches into virtually every State in the Union. In recent years, losses sustained by potato farmers in seasons of over-production have seriously affected the agricultural economy, and pointed up the need for profitable processing outlets for potato surpluses to keep the industry prosperous.

Fig. 1.—The Eastern Utilization Research and Development Division headquarters in the Philadelphia suburb of Wyndmoor, Pa.

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Utilization research on potatoes is conducted by the U. S. Department of Agriculture in two widely separated installations of the Agricultural Research Service — the Eastern and Western Utilization Research and Development Divisions, located respectively in Wyndmoor, Pennsylvania, near Philadelphia, and Albany, California, near San Francisco.

The research in both Divisions is largely related to the processing of potatoes (Fig. 2). At the Eastern Division, with whose work this article primarily deals, potatoes are being analyzed for their amino acids and nonvolatile organic acids, specific potato-processing problems are being attacked, and new products made of or containing potatoes are developed and improved. The Western Division is conducting research on potato lipids and their oxidation products, and on the starch and other polysaccharides that largely control the texture of processed potato products. The Eastern Division is probably best known for its development of potato flakes (Fig. 3), while the Western Division developed the airlift dryer and the fluidized bed dryer and made other significant improvements in the process for making potato granules.

Potato Analysis

A comprehensive study of the total nitrogen, amino nitrogen, and amino acids of potatoes is a vital part of the Eastern Division's research program (Figs. 7, 9, 10). The potato contains no less than 22 amino acids, including all 8 of the so-called essential amino acids required for the human diet. It is of great nutritional importance therefore to establish how different cultural practices affect these constituents and what happens to them during storage or under various processing conditions. This work is not only revealing the great nutritional value of potatoes, which has not always been fully appreciated, but is also showing how this value can best be retained in processing.

In view of their nutritional significance, the amino compounds of potatoes may well be worth recovering as byproducts of potato-starch manufacture. At the suggestion of Eastern Division scientists, the value of these recovered compounds for use in certain food and fermentation products is now under evaluation by the industries concerned.

Besides the amino acids, there are other relatively strong organic acids in potatoes about which very little is known because of a lack of qualitative and quantitative methods for their analysis. Research at the Eastern Division has separated and identified the principal ones as citric, oxalic, glutamic, aspartic, pyroglutamic, and phosphoric acids. The knowledge obtained through such analyses is being applied to specific processing problems.

Processing Problems

Scientists of the Eastern Division devote a great deal of effort to overcoming specific difficulties encountered in processing potatoes. One of the most serious of these is the tendency of many potatoes that appear normal when raw to show a gray discoloration when cooked (Fig. 6). This after-cooking discoloration, which is more prevalent in potatoes grown east of the Mississippi River, has one peculiar characteristic that provides a lead as to its cause: it invariably occurs at the stem end of

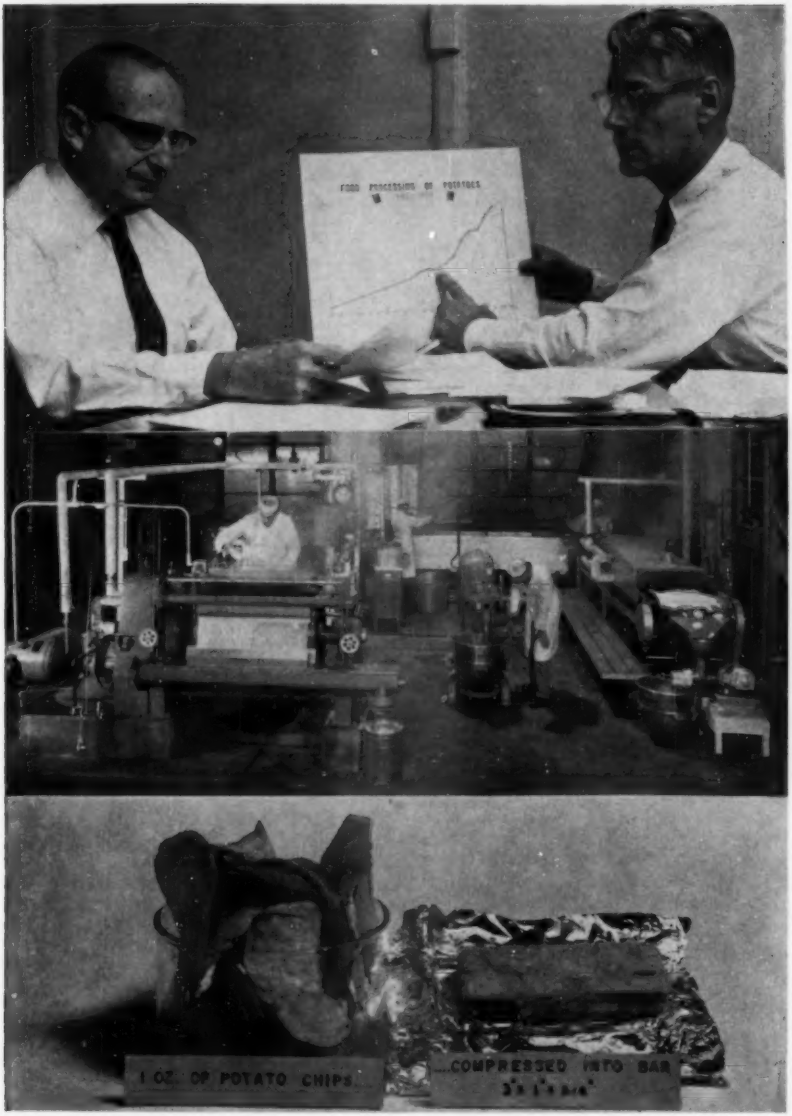

FIG. 2.—(Top) Dr. C. F. Woodward (right), Chief, Eastern Division's Plant Products Laboratory, discusses recent rise in potato processing with Dr. R. H. Treadway, Head of Laboratory's investigations on potatoes and other vegetables.

FIG. 3.—(Middle) Experimental production of potato flakes in Eastern Division's pilot plant.

FIG. 4.—(Bottom) Potato chip bar, snack developed by Eastern Division. Made by pressure-molding potato chips. bars retain the flavor and crunchy texture of chips, would be easier to ship and store.

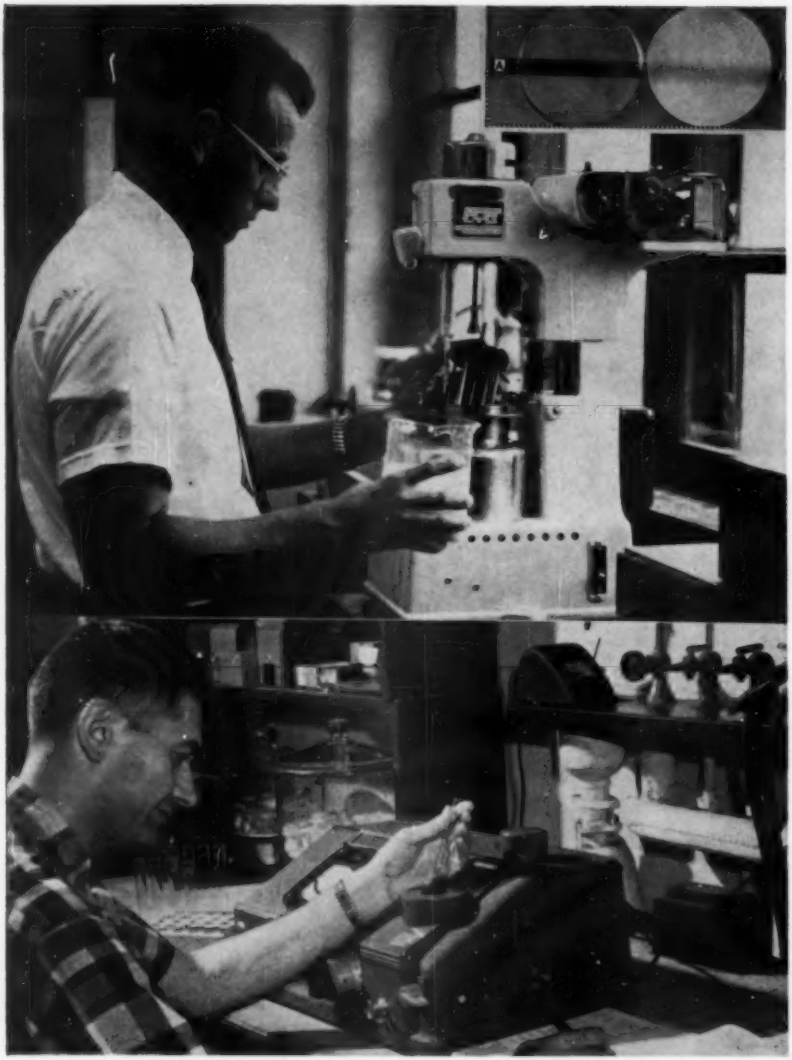

FIG. 5.—(Top) The Brabender viscograph, here being operated by Mr. E. G. Heisler, is used to determine action of monoglycerides, which are added to such products as potato flakes to improve their texture. Since monoglycerides are presumed to act primarily on starch, their effect on gelatinization temperature and viscosity of potato starch samples is measured in this apparatus. Monoglycerides also make starch solutions opaque (compare *A* and *B*, inset), thus probably improving not only texture, but also appearance, of reconstituted potato flakes.

FIG. 6.—(Bottom) Spectrophotometer used by Mr. J. Siciliano to record reflectance of a potato-extract sample in work on discoloration of potatoes.

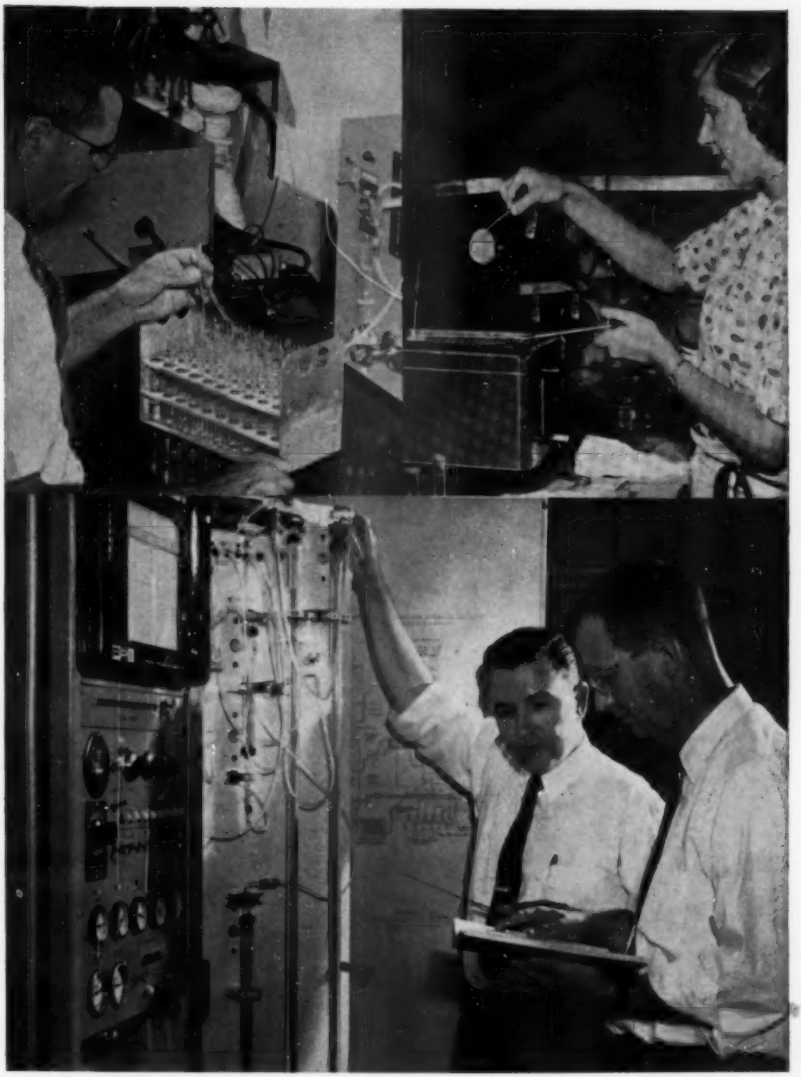

FIG. 7.—(Top, left) Nitrogen compounds in potatoes analyzed chromatographically by Dr. E. A. Talley.

FIG. 8.—(Top, right) Cornell University Agricultural Experiment Station technician studies potato-chip browning for Eastern Division. Deep-fat frying paper disks impregnated with various acids and sugars confirmed that reaction of sugars with non-protein nitrogen compounds of potatoes causes browning, but failed to implicate protein fractions.

FIG. 9.—(Bottom) Automatic amino acid analyzer permits complete analysis to be made in 24 hours, with only 4 hours of analyst's time, as against 6 full days of work required by conventional chromatographic equipment. Here, Dr. W. L. Porter (right) discusses results with Mr. T. J. Fitzpatrick.

the potato. The scientists have found more of a phenolic compound called tyrosine in the stem end than in the bud end. They think the enzyme tyrosinase, which converts tyrosine to a dark pigment in the presence of oxygen, may be at least indirectly responsible for the discoloration. Another possibility is that the iron and potassium in the potato may be responsible, since extracts from the stem end of the potato contain more iron and less potassium than those from the bud end.

The potato-chip industry has serious difficulty with some potatoes that make dark chips with a scorched taste. Although preventive measures, such as dipping the potatoes in hot water or hot sodium bisulfite solution before frying, are somewhat effective, the exact mechanism is not yet well enough understood to overcome the problem. It has been well established, however, that the reaction of the sugars in potatoes — both reducing sugars and sucrose — with the nitrogen compounds causes chip browning. A recent study for the Eastern Division by the Cornell University Agricultural Experiment Station discounted the possibility that the protein fractions of the potato as well as the nonprotein nitrogen compounds might be involved in the reaction (Fig. 8).

The growing use of prepeeled potatoes in restaurants and institutions has been aided by the development of a simple, rapid procedure for determining sulfur dioxide in raw peeled potatoes. With this new tool, research is progressing to improve the pickup and retention of sulfur dioxide in prepeeled potatoes. The method has also been extended to potato flakes, and its use by processors of this product promises better control over the degree of sulfiting.

In common with other food processors, the manufacturers of potato products face many difficulties in connection with the treatment and disposal of their wastes. Investigations have shown that a satisfactory reduction in the biochemical oxygen demand of potato starch factory effluents can be achieved by a method originally developed for the treatment of dairy wastes by the Eastern Utilization Research and Development Division in cooperation with Pennsylvania State University.

More recently, a study of fruit and vegetable processing wastes at 15 canneries was performed by Manhattan College under the supervision of the Eastern Division. This work has pointed to the value of reducing the biological oxygen demand of the wastes by passing them through trickling filters; by treating them with activated sludge; and by pumping them into lagoons or large open earth pits supplied with a minimum of 1 part per million of dissolved oxygen to avoid odorous end products. Spray irrigation was also indicated as an effective means of disposing of such wastes provided a relatively level site well covered with vegetation is available, the soil is light in texture, and the water table at the spray site is not too shallow.

New Products

Engineers of the Eastern Utilization Research and Development Division are responsible for the phenomenally successful dehydrated mashed-potato product known as potato flakes. Now in their fourth year

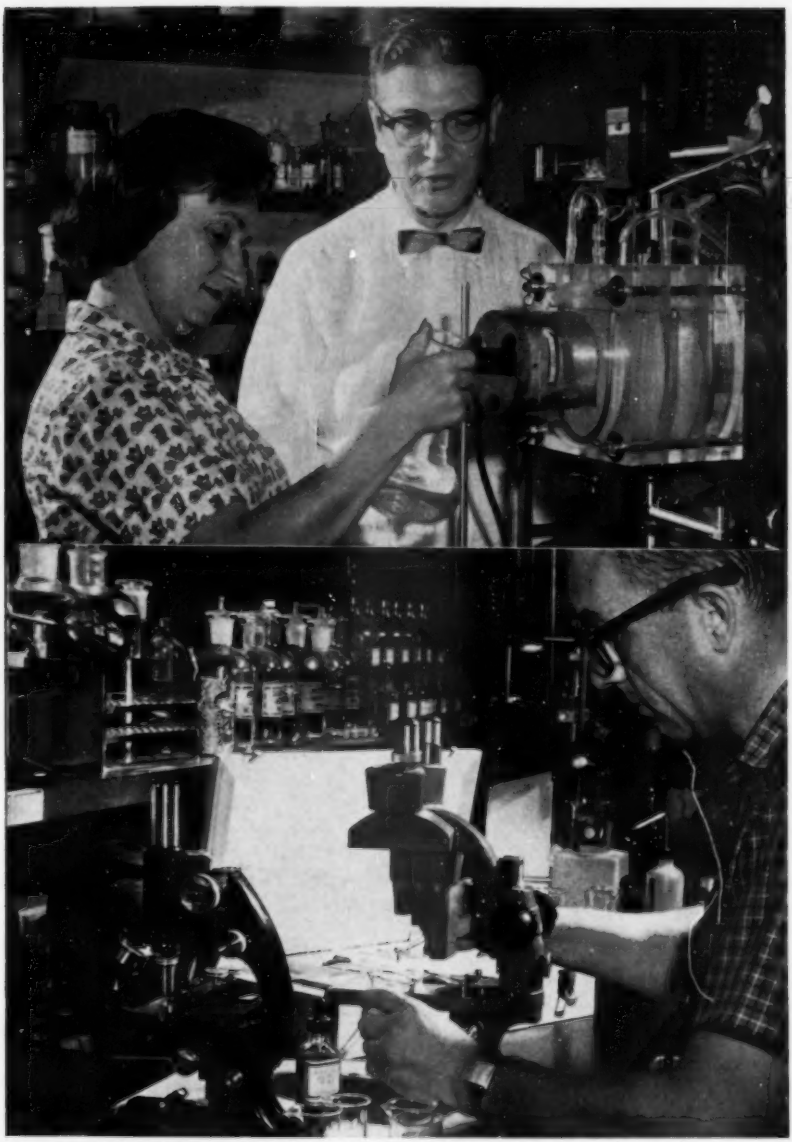

FIG. 10.—(Top) Electro-dialysis equipment which can be used to separate the non-protein from the protein constituents of potatoes. Operating the apparatus is Mrs. Reba R. Greenspun, under direction of Dr. E. G. Kelley.

FIG. 11.—(Bottom) Mr. L. R. Ross making microscopic analyses of potato flakes as part of the Eastern Division's continuing program to assist the potato-processing industry in solving specific problems.

of commercial production, potato flakes are being made in 11 new factories with a combined capacity of more than 60 million pounds of flakes, or about 7 million bushels of potatoes. The process, involving the drying of freshly mashed potatoes on the hot surface of a revolving drum, produces flakes that rehydrate to mashed potatoes almost indistinguishable in flavor and texture to the fresh. By precooking, cooling, and adding emulsifiers, flakes can be made that reconstitute to an exceedingly mealy mashed potato because free soluble starch is virtually eliminated (Figs. 5 and 11). Recently, processes for increasing the package density of potato flakes have been developed, making the product attractive for use in military field rations and other special applications where bulkiness is objectionable.

Other new potato products developed at the Eastern Division, but not yet in commercial production, are potato nuggets and the potato chip bar (Fig. 4). Nuggets, which were developed in cooperation with the Maine Agricultural Experiment Station, are made by deep-fat frying potatoes cut into ¼-inch dice. The potato chip bar is made by crushing chips and molding them by pressure into a shape and size resembling a candy bar. Such bars can be shipped economically without the protective packaging normally required for potato chips, and their flavor and crunchy texture give them distinct possibilities for commercialization.

Such fundamental and technological investigations as mentioned in this brief article are being continued, with the objective of developing new and improved uses for potatoes.

SOIL APPLICATION OF INSECTICIDES FOR THE CONTROL OF FOLIAGE PESTS OF IRISH POTATO[1]

R. N. HOFMASTER AND E. M. DUNTON, JR.[2]

INTRODUCTION

Soil insecticides such as aldrin, dieldrin or heptachlor have been widely accepted as a means of combating wireworms, white grubs, cutworms and other subterranean pests of Irish potatoes. In addition, tests by Hofmaster (2, 3) have conclusively demonstrated that potato flea beetles, *Epitrix cucumeris* (Harr.), and Colorado potato beetles, *Leptinotarsa decemlineata* (Say), pests which are predominately foliage feeders, are vulnerable to soil insecticides at one or more stages in their life cycles. As a result of these investigations, considerable potato acreage in Virginia is now treated with aldrin or dieldrin, applied primarily for the control of foliage pests. Unfortunately, however, these chemicals do not control aphids and leafhoppers.

The development of systemic insecticides effective against aphids and leafhoppers, together with formulations suitable for application to the soil, has aroused interest in these chemicals as a means of potato insect control. Klostermeyer (5), Landis et al. (7), Sleesman and Hedden (8) and Bacon (1) have reported the successful use of systemics against potato insects.

At least one important virus of potatoes has been largely controlled through the use of Thimet. Knoke and Chapman (6) and Hoyman (4) reported a significant decrease in the incidence of purple top wilt, a virus transmitted by the six-spotted leafhopper, *Macrosteles fascifrons* (Stal.), following the use of Thimet on Irish potatoes. Hoyman (4) found that Thimet was not effective in reducing the incidence of potato virus Y.

Investigations with Thimet applied at planting as either a granular, or an emulsion, or a carbon formulation have been under way in Virginia since 1956. Thimet in broadcast applications, seed piece treatments, and banded or placed in the furrow was studied. Banding or placing the granular formulation in the furrow was regarded as the most practicable method of application and was used in the following experiments. Disyston, another systemic granular, was also included in some of the later tests.

MATERIALS AND METHODS

Irish potato seed pieces of the Pungo variety were dropped in the row with a mechanical planter, and the granular formulations applied directly on top of the potatoes with a small seeder. The rows were then closed in the conventional manner. No insecticides were applied during the entire growing season. All plots were 0.1 acre in size and replicated 4 times in randomized blocks.

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[2]Entomologist and Soil Scientist, respectively, Virginia Truck Experiment Station, Eastern Shore Branch, Painter, Va.

Several methods of evaluating control of the different pests were employed. Potato leafhopper nymphs, *Empoasca fabae* (Harr.), and potato aphids, *Macrosiphum solanifolii* (Ashm.), were counted by checking 25 potato leaflets selected at random from each plot. The relative abundance of potato flea beetles was determined by recording the number of feeding scars per one-half square inch leaf plug excised from each of 25 separate leaflets. All plants in 25 hills were dissected in checking for European corn borers, *Pyrausta nubilalis* (Hbn.).

The effects of soil treatments upon the life cycle of DDT-dieldrin resistant and non-resistant Colorado potato beetles were studied in a somewhat different manner. Twenty newly hatched Colorado potato beetle larvae were caged on each of 5 plants per plot May 19, 1960 and checked for adult emergence. The DDT-dieldrin resistant larvae were obtained from Nandua, Virginia, a section of the Eastern Shore in which potato beetles have developed almost total resistance to DDT, dieldrin and other chlorinated hydrocarbons. (Unpublished data).

Results and Discussion

Observation of Table 1 shows that a single application of Thimet at either 2 or 3 pounds actual per acre held potato flea beetles, potato leafhoppers and potato aphids in check during the entire 1959 season. The performance against potato flea beetles was especially striking since the foliage in the check was heavily scarred yet adjacent treated rows were virtually untouched.

Significant yield increases occurred in the Thimet-treated plots. This increase is not believed to be caused by any one specific insect but rather to a general suppression of the potato foliage insect complex.

Results against the European corn borer were considerably less outstanding with only the 3 pound rate of Thimet giving an appreciable decrease (75%) in borer infestation. Data from this test and others suggest that corn borer control with Thimet is erratic at best and should be supplemented with regular insecticide treatments. Apparently, any effect on this pest should be regarded merely as a bonus obtained through applying Thimet for the control of other foliage feeders.

The data presented in Table 2 clearly indicate what might be expected in the way of a reduction in potato yield if insects are allowed to increase unchecked at the end of the growing season. It will be noted that single applications of Disyston and Thimet at 2.5 pounds per acre at planting gave excellent potato leafhopper protection up to harvest. The potato vines were dead or dying in the untreated check by June 25 yet remained green in the treated area for another 4 weeks, despite a potential leafhopper infestation of at least 40 nymphs per leaflet. Yields were increased from an average of 300 cwt per acre in the check to more than 400 cwt in the Disyston and Thimet treatments — more than 33%. The heptachlor treatment had no effect on the numbers of leafhoppers or plant yield.

It is of interest to note that Bacon (1) reported similar long term protection with Thimet and Disyston granulars against closely related but different species of insects than those reported herein. The leafhopper, *Empoasca filamenta* Del., and the tobacco flea beetle, *Epitrix hirtipennis* Melsh., were held in check 80-85 days with these systemic granulars applied at planting.

TABLE 1.—*Soil application of Thimet granulars to control foliage pests of Irish potatoes.*[1] *Painter, Va. 1959.*

Treatment	Rate/A. (Lbs. actual)	Insect infestation or damage per 25 samples June 26, 1959.				Yield 100-lb. bags U.S. No. 1 potatoes 7-10-59
		Flea beetle scars	Leaf-hopper nymphs	Potato aphids	Hills infested with corn borers	
Thimet (5%) granules	2.0	49	13	6	15	146
Thimet (5%) granules	3.0	61	13	8	4	160
Check	--	869	145	225	16	120
L.S.D. (5%)		59.6	19.5	31.4	6.2	24.9
L.S.D. (1%)		90.0	29.4	47.4	9.4	37.6

[1]Pungo variety, planted and treated March 26, 1959.

TABLE 2.—*Soil application of insecticides to control foliage pests of Irish potatoes.*[1] *Painter, Va. 1960.*

Treatment	Rate/A. (Lbs. actual)	No. potato leafhopper nymphs per 25 leaf samples at 3 dates.			Yield 100-lb. bags U.S. No. 1 potatoes 7-21-60	Specific gravity
		6/20	6/30	7/8		
Disyston (10%) granules	2.5	7	26	50	414	1.0826
Thimet (10%) granules	2.5	5	30	46	405	1.0804
Heptachlor, EC	3.0	99	511	903	304	--
Check	--	141	500	1001	300	1.0684
L.S.D. (5%)		26	70	112	46	
L.S.D. (1%)		37	100	160	65	

[1]Pungo variety, planted and treated March 29, 1960.

Both Disyston and Thimet were effective in preventing non-resistant Colorado potato beetles from completing their life cycles (Table 3). However, these compounds gave only partial control of DDT-dieldrin resistant beetles. Heptachlor decreased the emergence of non-resistant beetles approximately 92% but had no effect on the resistant strain.

Benefits, other than direct insect control, occurred following the use of the granular systemics. Specific gravity readings were consistently

TABLE 3.—*Effect of soil treatments on the life cycles of DDT — dieldrin resistant and non-resistant Colorado potato beetles. Painter, Va. 1960.*[1]

Treatment	Rate/A. (Lbs. actual)	Number of Colorado potato beetle larvae completing life cycle per 100 observed			
		Non-resistant		DDT-Dieldrin resistant	
		Entered soil	Adults emerged	Entered soil	Adults emerged
Disyston (10%) granules	2.5	0	0	40	20
Thimet (10%) granules	2.5	0	0	32	21
Heptachlor, EC	3.0	71	4	78	54
Check	--	80	51	70	50

[1]Pungo variety of potatoes, planted and treated March 29, 1960.

higher in the Disyston and Thimet treated potatoes (Table 2). Tubers from the Disyston and Thimet plots had specific gravities of 1.0826 and 1.0804, respectively, as compared with 1.0684 in the check. This increase is quite important where potatoes are grown for chipping since a high specific gravity is most desirable. Tests by a commercial processor showed that the Disyston and Thimet treatments did not effect the quality of the chip.

In addition to the beneficial effects of an increased specific gravity, potatoes receiving systemic granular treatments did not have the stem end discoloration common to potatoes from the heptachlor and untreated areas. This discoloration was undoubtedly caused by the premature death of the plant as a result of the intense leafhopper infestation.

Observations at the Virginia Truck Experiment Station have emphasized the necessity of keeping Irish potatoes actively growing during the last 3 - 4 weeks of the season if maximum yields are to be obtained. Growers are prone to forget about insecticides once flea beetles, potato beetles and other obvious foliage feeders cease to be a problem. Yet, it is under these conditions that leafhoppers and aphids become abundant and literally "burn-up" the crop. The use of systemic granulars should, to a large extent, alleviate this condition.

SUMMARY

The effects of systemic granulars applied to Irish potatoes at planting were studied on 5 species of insects at Painter, Virginia.

Results in 1959 clearly indicated that both 2 and 3 pound per acre rates of Thimet gave excellent control of potato flea beetle, *Epitrix cucumeris* (Harr.), potato leafhopper,. *Empoasca fabae* (Harr.) and potato aphid, *Macrosiphum solanifolii* (Ashm.), throughout the season. The extent of European corn borer, *Pyrausta nubilalis* (Hbn.), infestation

was reduced approximately 75% at the 3 pound level but the 2 pound rate was comparatively ineffective.

Both Thimet and Disyston granulars at 2.5 pounds per acre gave striking control of heavy potato leafhopper infestations in 1960. Yields were increased 100 cwt per acre compared with the untreated check — more than 33%.

The systemic granules prevented newly hatched Colorado potato beetle larvae, *Leptinotarsa decemlineata* (Say), from completing their life cycle. These compounds were only partially effective against DDT-dieldrin resistant larvae.

Of special interest is the fact that the specific gravity of Pungo potatoes in the Thimet and Disyston plots was consistently higher than in the untreated check.

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FIELD TRANSMISSION OF THE POTATO SPINDLE TUBER VIRUS AND VIRUS X BY CULTIVATING AND HILLING EQUIPMENT[1]

F. E. MANZER AND DONALD MERRIAM[2]

INTRODUCTION

In Maine in 1948 and for two or three years thereafter seed lots of the newly introduced Kennebec potato variety were seriously contaminated with spindle tuber virus. Attempts to eradicate this virus by roguing diseased plants failed because of its excessive spread during the growing season. This excessive spread could not be clearly explained since many growers had taken measures to reduce the spread resulting from seed cutting knives, seed-piece contact, insects and picker planters, the only methods of transmission considered to be important at that time (2, 3, 4). Furthermore, these avenues of dissemination, even if left unchecked, would not satisfactorily explain the high percentages of spread observed.

In 1951, Bonde and Merriam (1) showed that contact of bruised tuber sprouts with infective sap gave 50% transmission of the spindle tuber disease. This sprout inoculation appeared to be the most efficient method of spread of the virus until 1954 when Merriam and Bonde (6) reported 80-100% transmission by brushing healthy potato vines with diseased vines. Mechanical transmission of spindle tuber through the foliage had been shown as early as 1923 by Schultz and Folsom (7) to occur when infective sap was applied to mutilated leaves of healthy plants, but until the work of Merriam and Bonde (6) this method was not considered to be important under field conditions.

Merriam and Bonde (6) also found that tractor wheels contaminated by sap from spindle tuber infected plants could transmit the disease, and they suggested that other equipment used in producing the crop might likewise spread it. In the present study cultivating and hilling equipment was used to test their theory since such equipment can, if vines are large, cause considerable foliage damage. In addition to spindle tuber this study includes work on virus X which is also known to be easily transmitted through the foliage.

MATERIALS AND METHODS

An exploratory experiment was set up in 1957 in which nine potato varieties were subjected to contact inoculation with the spindle tuber virus by driving a tractor with mounted cultivating and hilling tools through the rows of potatoes (Fig. 1). The machinery had just previously been driven through two rows of the Saco variety which were known to be 100 per cent infected with spindle tuber. These operations were performed when the vines were 10 to 14 inches high in order to insure a high degree of vine contact with the equipment.

[1]Accepted for publication March 6, 1961.

[2]Associate Professor of Plant Pathology and Technical Assistant respectively, Maine Agricultural Experiment Station, Orono, Maine.

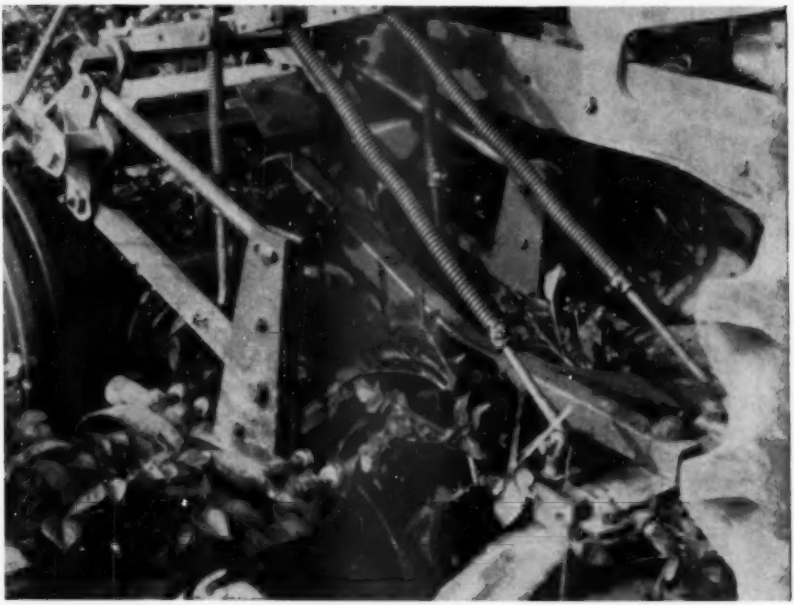

FIG. 1.—Tractor-mounted cultivating and hilling equipment. Note excessive contact of large vines with the equipment.

In similar experiments conducted in 1958 and 1959 attempts were made to measure the effect of the degree of vine damage on the amount of spread of virus X and of spindle tuber virus. The source of virus X was 100% virus X-infected Katahdin plants and the source of spindle tuber virus was 100% infected Saco plants. A medium amount of damage was obtained by driving the cultivating and hilling equipment through the plots once. More severe damage was obtained by travelling through the plots twice. Undamaged check plots were cultivated and hilled while the vines were still relatively small. Sprayers and other equipment travelled only in buffer rows. Disease-free seed of the Katahdin and Kennebec varieties was used in all of the test plots.

For disease readings a tuber was taken from every hill or every other hill of all treatments in each experiment. Samples selected for virus X readings were planted in the greenhouse and indexed using either *Gomphrena globosa* L. or *Datura stramonium* L. as indicator plants. Those selected for spindle tuber readings were planted whole in the field. No attempt was made to read current season symptoms of spindle tuber since previous experience has shown that such readings are unreliable.

Some of the spindle tuber samples saved from one experiment were used to compare the readings obtained in greenhouse plantings with those from field plantings to determine whether as suggested by MacLachlan (5), normal spindle tuber symptoms may not develop under

greenhouse conditions. Each tuber from these samples was cut in half and each half of each tuber was given the same number. The knives used were sterilized by flaming in alcohol after each cut. One-half of each tuber was planted in the greenhouse and the other half was saved for planting in the field. Fifty tubers each from the checks, medium, and severely damaged plots of both the Katahdin and Kennebec varieties were used for this comparison making a total of 300 tubers in all. Greenhouse readings were made in March and the field readings were made in July.

Results

Spindle tuber transmission. All of the nine varieties tested in 1957, were found to be susceptible to mechanical inoculation with the spindle tuber virus. The amount of infection ranged from 31% for Katahdin to 65% for Green Mountain (Table 1).

The results of tests on the degree of vine damage as affecting the amount of spread of spindle tuber are shown in Table 2. Several of the samples from the 1958 test were lost but the 1959 results clearly show that the amount of spread of spindle tuber varies directly with the degree of vine damage.

In the 1959 trial as a result of delay from rainy weather the final cultivation and hilling was not accomplished until after the vines had grown to the point where injury could not be avoided. For this reason completely undamaged check plots were not available. The data show that spindle tuber transmission did occur in the check plots and it was considerably greater in the Kennebec variety. This can be attributed to the fact that Kennebec vines tend to grow more rapidly early in the season than do those of the Katahdin variety and are therefore more prone to cultivator damage.

Virus X transmission. Transmission of virus X by mechanical means has long been known to occur and the results in Table 3 show that virus-X-contaminated cultivating and hilling equipment can be very effective in the dissemination of the disease through contact. Although the samples from undamaged plots were lost in the Katahdin experiment similar unpublished studies conducted by the junior author have shown that when care is taken to avoid vine contact during cultivating and hilling very little if any spread of virus X will occur even though virus X-contaminated machinery is used. The nearly equal amounts of virus X transmission obtained in the "medium" and "severe" Kennebec plots cannot be explained but these results might have occurred because of the failure to drive the tractor through the "severe" plots twice.

Greenhouse spindle tuber readings. Foliage symptoms of spindle tuber developed very readily under normal greenhouse conditions (Fig. 2). The plants, however, must be given adequate space to prevent abnormal elongation. Greenhouse readings agreed very closely with those obtained from field plantings with only five plants of the 300 being diagnosed differently in the two locations (Table 4).

Discussion and Conclusions

The data presented here and that from similar studies by others on foliage transmission of spindle tuber through mechanical contact can be

TABLE 1.—*Relative susceptibility of nine potato varieties to mechanical inoculation with the spindle tuber virus — 1957.*

Variety	Hills sampled	Hills infected	% infection
Cherokee	121	55	45.4
Chippewa	105	37	35.2
Delus	107	67	62.6
Green Mountain	109	71	65.1
Katahdin	100	31	31.0
Kennebec	100	51	51.0
Russet Burbank	96	57	59.4
Saco	114	52	45.6
Sequoia	119	71	59.7

TABLE 2.—*Field transmission of the spindle tuber virus by contaminated cultivating and hilling equipment.*

Vine contact	Hills sampled	Hills infected	% infection
1958		Katahdin	
None	Samples lost		
Medium	204	12	5.9
Severe	Samples lost		
		Kennebec	
None	239	2	0.8
Medium	Samples lost		
Severe	190	99	52.1
1959		Katahdin	
None	249	5	2.0
Medium	250	111	44.4
Severe	249	211	84.7
		Kennebec	
None	250	61	24.4
Medium	250	194	77.6
Severe	250	245	98.0

used to explain satisfactorily the reason why the disease is difficult to control. It can readily be seen also that the spindle tuber disease, under certain conditions, can be disseminated as easily as is virus X. The spindle tuber virus has not, however, become as universal among the older potato varieties as has virus X, probably for one or more of the following reasons. First, symptoms of the spindle tuber disease can be recognized, by the trained eye, in the potato vines and often in the tubers, whereas

TABLE 3.—*Field transmission of potato virus X by virus-contaminated cultivating and hilling equipment.*

Vine contact	Hills sampled	Hills infected	% infection
1958		Katahdin	
None	Samples lost		
Medium	100	64	64.00
Severe	118	110	93.2
		Kennebec	
None	140	0	0
Medium	165	93	56.4
Severe	185	99	53.5

TABLE 4.—*Comparisons of spindle tuber readings of duplicate samples grown under greenhouse and field conditions.*

Vine contact	Variety	Greenhouse readings[1]	Field readings[1]
None	Katahdin	5/50[2]	3/50
Medium	Katahdin	28/50[3]	27/50
Severe	Katahdin	43/50	43/50
None	Kennebec	10/50	10/50
Medium	Kennebec	46/50	46/50
Severe	Kennebec	50/50	50/50

[1]The fraction represents the number of plants diseased out of the total. Unless otherwise noted the greenhouse and field readings agree on an individual plant basis.
[2]Two weak plants were read in the greenhouse as having spindle tuber. Both plants were considered to be healthy in the field.
[3]One plant was read as healthy in the greenhouse but as diseased in the field, and two plants were considered to have spindle tuber in the greenhouse but were healthy in the field.

no obvious symptoms in the potato plant are produced by most strains of virus X. Secondly, even before spindle tuber was recognized as a virus disease, seed sources which yielded large percentages of misshapen tubers were discarded, automatically eliminating further increase of spindle tuber from those sources. A third possible reason could be that virus X is infective at much higher dilutions than is the spindle tuber virus. In the present studies only relatively massive amounts of inoculum of each virus were involved.

From these studies it would appear that the best method of preventing the spread of virus X and spindle tuber is to avoid sources of inoculum. Since in many instances this is either impractical or impossible it is

FIG. 2.—Healthy and spindle tuber-infected Kennebec potato plants grown in the greenhouse.

apparent that every effort should be made at least to avoid vine contact with machinery as much as possible. Fields suspected of harboring either of these virus diseases should not be worked until after each job is completed in disease-free fields. Exposure of virus-contaminated machinery to air and sun will reduce the danger of disease spread, but more rapid and reliable methods are needed for decontaminating machinery.

SUMMARY

Studies conducted over the past three years have shown that the spindle tuber virus and virus X can be disseminated very readily in potato fields by contact of healthy vines with contaminated cultivating and hilling equipment. Nearly 100% transmission of each virus was recorded in the Katahdin and Kennebec varieties in tests which simulated excessive contact of large vines with contaminated equipment. Under conditions of less severe vine contact a lesser amount of transmission of each virus was observed. When cultivation and hilling operations were performed before vines were large very little transmission of either virus was obtained. Greenhouse readings of indexed samples from the spindle tuber dissemination studies showed very close agreement with field readings.

Literature Cited

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2. Goss, R. W. 1926. Transmission of potato spindle tuber by cutting knives and seed piece contact. Phytopathology 16: 299-303.
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THE ONAWAY POTATO, AN EARLY VARIETY[1]

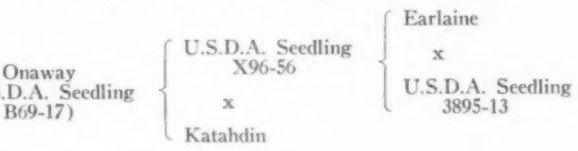
E. J. WHEELER[2] AND R. V. AKELEY[3]

Many new varieties of potatoes have been introduced recently but none possess the combination of early maturity and yielding ability of Onaway particularly when grown in the early potato-producing area of Munger in Bay County, Michigan. Tested in Michigan under pedigree number B67-17, Onaway is a selection from the National Potato-Breeding Program, Crops Research Division, United States Department of Agriculture. Among the seedlings that were tested on the Walter Schultz farm near Munger, Seedling B67-17 (Onaway) proved to be superior to all others including the Irish Cobbler. Seed of the Onaway variety was subsequently increased in Presque Isle County, near Onaway, in the northwestern part of the Lower Peninsula of Michigan. Onaway seed was first certified in Michigan in 1956. The town of Onaway is located in one of the great lumbering areas of this State and is the county seat of Presque Isle County.

Table stock growers in southern Michigan are especially interested in the Onaway variety. When planted in April, it will produce better yields of mature tubers than most other early-maturing varieties grown for the August and early September markets. Onaway, therefore, provides large-scale commercial growers with a supply of mature potato tubers enabling them to extend their marketing season over a longer period.

ORIGIN

Onaway was grown first at Aroostook Farm, Presque Isle, Maine. Along with many other selections, a single tuber of Onaway was sent to Michigan for testing. Its complete pedigree follows:



The pedigree contains varieties and seedlings widely tested and with known characteristics. Katahdin possesses field immunity from mild mosaic and has some scab resistance. Seedling X96-56 is specifically immune from the common races of late blight and also has some general field resistance to other races of the organism. It also matures early and has field resistance to mild mosaic.

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[1]Accepted for publication May 8, 1961. Contribution No. 2787 from Michigan State University, Agricultural Experiment Station and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

[2]Farm Crops Department, Michigan State University, East Lansing, Michigan.
[3]Agricultural Research Service, Crops Research Division, Beltsville, Maryland.

Description

PLANTS.—Early maturing, medium to large, upright. *Stems*: large, thick, prominently angled. *Nodes*: slightly swollen and reddish. *Internodes*: reddish. *Wings*: prominent and extremely waved. *Stipules*: on leaves, small, green, scantily pubescent. *Leaves*: medium-sized, green. *Midrib*: green and pubescent. *Petioles*: green. *Terminal leaflets*: medium to large, elliptical ovate, acute, symmetrical. *Primary leaflets*: medium-sized, elongated, narrow, 3 pairs, mean length 58.3± 0.5 mm (2.3 inches), mean width 38.2 ± 0.2 mm (1.5 inches), index length to width 65.4 ± 0.4. *Secondary leaflets*: medium to many, between pairs of primary leaflets and at junction of midrib and petioles. *Tertiary leaflets*: few, small. *Inflorescence*: much branched. *Leafy bracts*: small. *Peduncles*: in axils of petioles and main stem, short, green, slightly pubescent. *Pedicels*: short to medium, slightly reddish.

FLOWERS.—*Buds*: green. *Calyx lobes*: short (5.6 mm), awl-shaped; tips curved, green. *Corolla*: small-sized (15-20 mm), pink to reddish. *Anthers*: orange yellow, pollen medium to abundant and of fair quality. *Style*: straight. *Stigma*: globose, single-lobed, green.

TUBERS.—Short, cubicle, medium thick, mean length 83.4 ± 0.7 mm (3.3 inches), mean width 74.1 ± 0.5 mm (2.9 inches), mean thickness 60.7 mm ± 0.4 mm (2.4 inches); indexes, length to width 88.9 ± 0.6, length to thickness 73.6 ± 0.2, width to thickness 82.2 ± 0.7. *Skin*: slightly flaked when mature. *Eyes*: medium deep. *Flesh*: white. *Sprouts*: pink. *Maturity*: early.

General Characteristics

Onaway has been carefully observed and tested for several years. It has been grown commercially for the past 8 years in the Bay County early potato-producing area and more recently in the southern production areas of Michigan. Although this variety is resistant to common scab and to late blight in the field, these desirable characteristics alone have not made it outstanding. Growers particularly like its ability to produce mature tubers of uniform size early in the season and to yield higher than other early-maturing varieties, especially Irish Cobbler (Table 1).

TABLE 1.—*Yields, percent, and average size of U. S. No. 1 tubers of Onaway compared with those of Irish Cobbler grown in Michigan and harvested August 16, 1957.*

Variety	Total	Yield per acre		Average size of U. S. No. 1 tubers
		U. S. No. 1	U. S. No. 1	
	Cwt.	Cwt.	Pct.	Oz.
Onaway	400	381	95	6-7
Irish Cobbler	308	261	85	4-5

Onaway is susceptible to verticillium wilt (*Verticillium albo-atrum*) and early blight (*Alternaria solani*) and this presents a problem. Special emphasis must be placed on the production of high-yielding strains of foundation seed reasonably free from both of these diseases. Table stock growers are urged to purchase new seed each year from competent seed growers. Some years tuber infection with early blight is so heavy that seed production is unprofitable except in the cooler areas of northern Michigan. Very little trouble from early blight is encountered if the tubers are stored within the areas where they were grown. When the tubers of Onaway grown in the northern areas are harvested and immediately transported and stored in the tablestock-producing areas for future use as seed, early blight often develops. Little loss in seed stocks is encountered in these shipments if the tubers are precooled before they are transported.

Unless good stands of Onaway are obtained many tubers will become oversized and very rough. Closer spacing of the plants will reduce the number of undesirable tubers and give greater uniformity in tuber size.

The texture of Onaway when cooked is rated as waxy and similar to that of many other varieties that mature in the heat of the summer. Its specific gravity will vary according to the locality in which it is grown, ranging from 1.066 to 1.076 (16.7 to 18.8% total solids). The early-planted crops of Onaway usually produce tubers of higher specific gravity than do the late ones. Because the pectin content of Onaway tubers is often higher than that of other varieties a few minutes more are required for cooking this variety. Many chip tests with Onaway indicate that its chip color is frequently too dark for commercial use.

Summary

The Onaway variety is resistant to common scab, late blight, and mild mosaic, but susceptible to verticillium wilt and early blight. It is a high-yielding, white-skinned early variety that produces medium to large tubers with fair cooking quality. Chip tests do not rate it as one of the better varieties for chipping. It is adapted to sandy soils well supplied with organic matter. Its tubers will grow very large and rough unless prevented by close seed spacing.

The advantages from planting seed produced by a competent seed grower are more apparent with Onaway than with most other potato varieties. Consequently, most seed growers of this variety have the seed stock sold before the crop is planted.

NEWS AND REVIEWS

MINUTES OF POTATO ASSOCIATION OF AMERICA

Executive Committee Meeting

Columbia Hotel, Wenatchee, Washington, July 26, 1961

7:45 PM — Meeting called to order by President, O. C. Turnquist.

Members present:

Walter Sparks, Robert Treadway, Orin Turnquist, Robert Akeley, Paul Eastman, L. C. Young, Charles Cunningham, John Campbell, R. L. Sawyer

Discussion of how to elect honorary life members.

Paul Eastman suggested that a member of the Committee up for election for honorary life membership should be excused from voting.

Robert Akeley made the motion that there be two technical members and one non-technical member elected for honorary life membership next year. Walter Sparks seconded, motion carried.

Walter Sparks made the motion that a vote be made for 5 technical and 3 non-technical nominees and Robert Akeley seconded. Motion carried. First choice would be given the person receiving highest number.

Discussion on what the Association should do in contacting last ten past Presidents for voting on honorary life membership. O. C. Turnquist suggested we contact the last ten Presidents that are available.

Meeting place for next year.

Orrin Turnquist extended an invitation from the Red River Valley to meet at Grand Forks in 1962 in late August to coincide with travel to A.I.B.S. meetings.

Richard Sawyer extended an invitation from the Long Island area for 1963 for a back-to-back meeting with the Potato Utilization Conference.

Walter Sparks extended an invitation from Idaho for 1964.

All agreed on Red River Valley area for 1962.

Handbook

John Campbell discussed handbook situation. 1962 handbook will be on potato storage with specific articles by 5 or 6 experts who have accepted the invitation to write.

POTATO ASSOCIATION OF AMERICA

Annual Business Meeting and Committee Reports

Columbia Hotel, Wenatchee, Washington, July 27, 1961

2:40 P.M. — Meeting called to order by President, O. C. Turnquist.

Minutes of the last meeting. John Campbell moved they be accepted as published in the Potato Journal. Paul Eastman seconded. Motion carried.

Treasurer's Report, by John Campbell. Motion for acceptance made by John Campbell, seconded by Paul Eastman, and carried.

The following committee reports were presented and accepted:

Auditor's Report by Donald Isleib;
Membership Report by John Campbell;
Editorial Report by John Campbell;
Handbook Committee Report by Robert Akeley;
Potato Certification Report by Robert Akeley, who read a note from Henry Darling, chairman of the committee.
Virus Disease Investigations Committee Report by Dr. Wright;
Late Blight Investigation Committee Report by Dr. Eide;
Utilization Committee Report by Paul Xander;
Crest and Seal Committee Report by John Campbell;
Honorary Life Membership Committee Report by Paul Eastman.
Standards Committee Report by Ora Smith.

Policy Committee Report. R. L. Sawyer reported that the Executive Committee, at the July 26 meeting, recommended that an evaluation of dues be made to enablle the Association to be prepared to stand alone with a sound economic structure. Julian Miller made the motion that the Executive Committee evaluate the situation and adjust dues accordingly, giving strong consideration to a sustaining membership drive. Jake Lutz seconded. Motion carried. The motion was amended by John Hansen and seconded by Paul Eastman that dues be increased to $6.00 for the coming year. Motion carried.

Foreign Relations Committee Report by Ora Smith. Gus Rieman suggested the Foreign Relations Committee be of a rotational or continuing nature for more effective results with the consideration of an international meeting.

New Business.

Paul Eastman suggested that the Association should be considering the approaching 50th meeting for special attention.

O. C. Turnquist reported that an invitation for the 1962 meeting was given by the Red River Valley area to meet in Grand Forks, probably in late August.

An invitation has been extended by R. L. Sawyer to meet in a back-to-back meeting with the Potato Utilization Conference in 1963 on Long Island. The Potato Utilization Conference has already accepted an invitation for this Long Island meeting.

An invitation was extended by Walter Sparks to meet in Idaho in 1964.

Elmer Ewing cautioned that meetings be scheduled so as *not* to coincide with other national meetings, specifically A.I.B.S.

Several people commented on the advisability of the Potato Association meeting separately, in potato areas, or at Universities, or setting up a meeting schedule for several years in advance.

Nominating Committee Report was made by Ora Smith who presented the following panel:

President	R. V. Akeley
President Elect	L. C. Young
Vice President	W. G. Hoyman
Director	H. M. Darling

Ora Smith moved they be elected. Robert Kunkel seconded.

Leo Dionne moved that nominations be closed, Paul Eastman seconded, motion carried.

Paul Eastman moved that the Secretary cast 1 ballot for the slate of Officers, Robert Treadway seconded, motion carried.

Secretary cast the ballot.

Resolutions Committee report was made by Julian Miller with a motion for acceptance, seconded by Ora Smith, and carried.

Move to adjourn by Paul Eastman, seconded by John Hansen.

Richard L. Sawyer, Secretary

FINANCIAL REPORT

THE POTATO ASSOCIATION OF AMERICA

August 1, 1960 to July 31, 1961

RECEIPTS

Balance in checking account, July 31, 1960	$6,703.54	
Annual dues	5,965.64	
Sale of advertising in Journal	3,096.72	
Sale of reprints	2,410.50	
Sale of back issues	435.99	
Sale of binders	35.50	
Donation from N. B., Canada for Speakers' Fund	245.53*	
Sale of advertising in 1961 Handbook	3,646.70	
Sale of Handbooks	569.93	
General	83.10*	
Total receipts		$23,203.15

DISBURSEMENTS

Printing Journal (12 issues)	$6,722.50	
Mailing & supplies	943.50	
Printing reprints	986.26	
Purchase of back issues	42.40	
Salaries: E. Campbell (Bookkeeping, billing, etc.)	720.00	
J. Campbell (Editing Journal)	900.00	
E. Clark (Proof reading Journal)	330.00	
Commission on Journal advertising (15%)	464.50	
Rental of machine for metered postage	109.72*	
Donation to Speakers' Fund ($245.53 from Canada)	500.00*	
Extra secretarial work	132.64*	
Meeting expenses (Programs, certificates, etc.)	68.34*	
Handbook expenses (Printing, editing, mailing, etc.)	3,377.01	
General	75.13*	
Total disbursements		$15,372.00
BALANCE in checking account, July 31, 1961		$ 7,831.15

SAVINGS ACCOUNTS

In bank July 31, 1960	$2,151.88	
Interest	70.47	
Total in account July 31, 1961		$ 2,222.35

Speakers' Fund

Deposited December 1, 1960	500.00	
Interest	7.52	
Total in account, July 31, 1961		507.52

Lelah Starks Fund

In bank July 31, 1960	481.83	
Interest	12.12	
Total receipts	493.95	
Disbursements		
Printing of reprints of articles of foreign authors	85.00	
Total in account, July 31, 1961		$ 408.95
Total Assets, July 31, 1961		$10,969.97

*In General Fund.

REPORT OF POTATO UTILIZATION COMMITTEE

The year 1960 has indicated a marked advance in our knowledge of the potato in the fields of diseases, growing, and processing, as well as breeding for both table stock and processing.

Sprays of many types and for various purposes have increased. Dr. D. E. H. Frear has 9,072 product listings in his 1961 Pesticide Handbook. The use of preventive sprays has increased the quantity and the quality of potatoes grown in the U.S.A. To the processor, the source of these sprays present a problem because of Food and Drug rulings. Better insect control, together with good agricultural practices, has lowered incidence of disease in most areas.

Breeding in the U.S. and Canada has continued, with several named varieties placed in production. Stevenson and Cunningham of Red Dot Foods, have successfully cross-bred over 150 numbered varieties to produce good chips at harvest and from storages ranging from 38 to 50 F in two to six weeks holding time. Xander and Hoover of Wise Potato Chips, are continuing their examination of the gene-enzyme theory and have secured good results on three enzymes influencing color with correlation at the 1% level on over 50 named varieties and numbered seedling varieties. The U.S.D.A. breeding program and those of the various universities and several private breeders are continuing. For a complete list we refer the reader to the National Potato Breeding Program report as edited by Robert V. Akeley and others and State Cooperators, published by the U.S.D.A. Agricultural Research Service, Crops Research Division, Beltsville, Maryland — 31st Annual Report dated March 1961.

Two new developments in potato dehydration have been reported by R. K. Eskew, Chief of the Engineering and Development Laboratory, Eastern Utilization Division, U.S.D.A. A new dense potato flakelet retaining the good property of potato flakes and new instant potato pieces in ½" cubes or larger, which can be reconstituted in about 6 minutes.

Dr. Carl E. Handel, U.S.D.A., Western Laboratory, has described new processes for producing potato granules without add-back and has examined the use of calcium stearate and gum karaya as additives to prevent stickiness and graininess in the product. Dr. Ron G. Buttery has identified and reported on seven previously unreported fatty acids found in dehydrated potato granules through gas liquid chromatography, and correlated the degree of off-flavor due to potato lipids with absorbed oxygen. A total of 13 compounds contributing to off-flavor were identified.

Dr. William L. Porter, Eastern Utilization Laboratory, U.S.D.A., has reported on work covering the nitrogenous constituents and total solids and the storage effects on same.

Numerous other reports have been published in the American Potato Journal, and for the sake of brevity we have mentioned only a few phases of research work in progress.

By geographic areas we find Maine is selling more of its crop to processors as industrial facilities are developed, contingent upon increased demand for processed potato products.

New York, Pennsylvania, and New Jersey are selling a large percentage to processors. The southeastern area, particularly Florida is selling up to 50% of its crop to processors, especially chippers.

Red River Valley area now has four flake plants; two starch and flour plants. In the process of development are two frozen potato products plants. Two other firms are manufacturing chips and frozen products.

California's early crop is going into processing particularly potato chips to a greater extent. Idaho, after expansion of processing products has now reached a plateau with a possible slower rate of processing growth.

Potato Processing — National Picture:

According to Dr. Frank J. McArdle, Pennsylvania State University, the following trends and developments are indicated: (i.) With the exception of canned potatoes, production of processed products will expand rapidly in the future. (ii.) Potato chip production will expand about 33% by 1965. The increase should then level off to about 10% increases for 1970 and 1975. This reduced rate of expansion seems certain to result from deemphasis of fats in the diet. (iii.) Production of frozen potato products will expand at least 300% by 1975. This expansion will be due to two factors: the popularity of frozen prepared dinners, most of which include a potato product, and the appeal of frozen French fries to restaurants and hotels. (iv.) Production of dehydrated potato products will increase at least 300% by 1975. This expansion will be possible because of the popularity of instant mashed and fried potato products in the home. The acceptance of these products after the notorious reputation which they developed during World War II is an illustration of the advances made in food technology generally. ,v.) Canned potato production

will probably not increase appreciably in the future. There will probably be sufficient demand for the product to maintain a market, but competition from other forms of processed potatoes will prevent further expansion."

We predict a bright future for potato processing during the coming decade.

We acknowledge with thanks information received from Dr. F. J. Stevenson and Charles Cunningham — Red Dot Foods; Kris P. Bemis, Secretary, United Potato Division, Fresh Fruit and Vegetable Association; 1960 Annual Summary, U.S.D.A. Agricultural Marketing Service.

Utilization Committee
Paul A. Xander
Charles E. Cunningham
Robert H. Treadway

REPORT OF POTATO VIRUS INVESTIGATIONS COMMITTEE

The potato virus diseases that are of most concern in commercial potato crops at present are those caused by the leaf roll and spindle tuber viruses.

Investigational work on these two viruses is being carried out in both U.S.A. and Canada but without close liaison.

Leaf Roll: Little progress has been made in attempts to obtain seedlings with satisfactory resistance to leaf-roll other than degrees of resistance to infection in the field. In regard to control of this disease, Dr. G. W. Simpson of Maine reports:

'The summer dispersal forms of potato infesting aphids in Maine have become much less abundant in recent years. This situation makes it possible to achieve a measure of control of some viruses by using insecticides to control vectors. Systemics applied in the soil at planting are especially promising because they protect plants against spring migrant aphids and materially delay the establishment of aphid colonies.

Recent experience suggests that spread of leaf roll may be reduced appreciably by the use of systemics applied in the furrow even where leaf roll plants are allowed to remain in the field all summer.'

Spraying experiments in New Brunswick, Canada, have shown that leaf roll spread may be reduced by applying insecticides frequently enough to keep aphid numbers well below the level where yields would be reduced by direct feeding. It requires more frequent applications of insecticides but the extra cost is not considered excessive.

These findings are of considerable value to seed growers because it will enable them to maintain their foundation stocks indefinitely.

In the Pacific Northwest (represented by lower Fraser Valley) the green peach aphid overwinters on cruciferous weeds and late fall crops such as cabbage. The prevalence of leaf roll virus in "volunteer" potatoes and in early potato crops provides the major source of virus. These plants become colonized by green peach aphids in May and June. Viruliferous winged aphids leave these sources in mid-August and fly to the main crop fields under those circumstances, of course, control of leaf roll is dependent on controlling the aphid population on the virus sources and to a much less extent in the main crop fields.

Spindle Tuber: The program of breeding for resistance to the spindle tuber virus in Maine is continuing and two seedlings are maintaining a resistance to infection caused by brushing leaf contact. The rising importance of this disease makes it imperative that much more should be known about the virus. A primary need at present is a good non-potato plant indicator.

Other Potato Viruses: Recent work in New Brunswick, Canada has shown that although severe mosaics caused by certain strains of potato virus X may not appear to be common in commercial potato crops, they are probably more infective than other strains.

The most likely new variety to be released from Fredericton, Canada, in the near future will be one that is hypersensitive to both viruses A and X. (F5350 - Hunter)

Recommendation: The members of this Committee recommend that a final decision on the venue of the Annual Meeting for the following year be made at each Annual Meeting. This would permit many who must plan financial outlays a year ahead to know exact commitments in regard to time, cost and travel. The doubt as to place and time during the year before an Annual Meeting, we believe, tends to lower the possible numbers that could attend the meeting. It would also ensure that a piece of work or a meeting proposed by one of the Committees could be fulfilled without fear of it being prevented because the date of the Annual Meeting was unexpectedly brought forward.

Franklin Manzer
W. J. Hooker
N. S. Wright
James Munro, *Chairman*

EDITORIAL COMMITTEE REPORT

Members of this Committee have reviewed approximately 30 manuscripts during the year. Most of these papers have required very little revising. A few manuscripts were rejected with a request to the author to rewrite the material or to publish elsewhere because the manuscripts did not present new information or adequate information.

A total of 55 research papers and several popular articles and book reviews were published.

We have 30 manuscripts on hand, enough to fill the Journal for about 7 months.

More papers of a general nature of particular value to producers and county agents are needed.

Instructions for the preparation of manuscripts have been prepared and will be published in the Journal soon. Reprints will be available for all who desire them.

We have changed our publishing style somewhat during the past year to follow the recommendations of the Committee on Form and Style of the Conference of Biological Editors of the American Institute of Biological Sciences. We recommend the use of the Style Manual for Biological Journals by all our authors.

The 1962 Potato Handbook will be devoted to potato storage problems and will contain five articles by authorities on the subject.

We plan to publish this valuable issue in November.

John C. Campbell
Arthur Hawkins
W. R. Mills
Ora Smith, *Chairman*

REPORT OF RESOLUTIONS COMMITTEE

BE IT RESOLVED that the Potato Association of America, meeting at Wenatchee, Washington, July 25 to 28, 1961, takes this opportunity to express their appreciation to the many people who made this one of the most successful meetings in years.

AND BE IT FURTHER RESOLVED that we wish to thank the local committee consisting of William, G. Hoyman, N. Sandar and Robert Kunkel for the excellent arrangements made for the meeting.

BE IT FURTHER RESOLVED that the Potato Association of America thanks the Northwest Association of Horticulturists, Entomologists and Plant Pathologists for their invitation and assistance.

BE IT FURTHER RESOLVED that the Potato Association of America wishes to thank the Homemakers 4-H Club groups for serving the excellent refreshments and barbecue dinner during the tour.

BE IT FURTHER RESOLVED that the Potato Association of America thanks the Washington Potato Growers' Association for their interest in the meeting and for making their facilities available for visitation.

BE IT FURTHER RESOLVED that the Association expresses their thanks to the Washington State Potato Commission for the mementos presented.

BE IT FURTHER RESOLVED that the Association expresses their appreciation to Mr. John Toeves of the Columbia Basin Project, U. S. Dept. of Interior, for giving the group highlights of the development of the Columbia Basin Project.

BE IT FURTHER RESOLVED that the Potato Association of America expresses their thanks to the management of the Columbia Hotel for providing the facilities for the meeting.

J. M. Lutz
Warren Trank
Julian C. Miller, *Chairman*

ABSTRACTS OF PAPERS PRESENTED AT THE FORTY-FIFTH ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

COLUMBIA HOTEL
WENATCHEE, WASHINGTON
JULY 25-28, 1961

BENSON, A. P. AND E. P. LANA

TESTING FOR FIELD RESISTANCE TO POTATO VIRUS Y

Field testing has thus far been the only satisfactory method developed for testing potato clones and seedlings for resistance to virus Y. Results from this procedure were found to be unsatisfactory with respect to uncontrolled insect vectors and contamination with viruses other than Y.

Tubers with both known and unknown degrees of field resistance to virus Y were cut, and paired in identical plantings. One planting was placed under large insect-proof cages screened with plastic mesh, and the other in the field. Randomly divided seedling progenies were also placed in both tests.. Duplicate samples were therefore maintained under both field and cage conditions.

Viruliferous aphids were placed on individual plants in the field several times during the season. This procedure was found to be unnecessary in the cages. Inoculum rows were maintained in both field and cage experiments.

All lines were hill indexed for the presence of virus Y during the winter months. Observed ratios of virus Y-free and Y-infected plants showed excellent agreement between field and caged materials in 2 years of testing. This agreement was further emphasized by comparison of ratios for susceptible checks.

Considerable time and effort can be saved by utilization of insect-proof cages in testing for field resistance to virus Y. Furthermore, the effects of uncontrolled insect vectors and environmental hazards may be minimized.

BENSON, A.P. AND R. H. JOHANSEN

EFFECT OF HOST RESISTANCE ON COMMERCIAL PRODUCTION OF VIRUS X-FREE POTATOES

Virus X-free selections from the North Dakota potato breeding program showing a low, moderate, or high degree of field resistance to that virus, were planted in increased blocks and handled with standard production methods. Field resistance was evaluated by the amount of field spread of virus X over a 3 yeear period. Several lines were also distributed to foundation growres to be increased under commercial conditions.

Following each growing season, several hundred hills from each selection were greenhouse indexed for the presence of virus X using the local lesion host *Gomphrena globosa* L. or by serological methods. Tubers found free of virus X by these methods were planted the following season. The procedure was repeated for 3 years.
Lines possessing little field resistance were found at times to be 95% infected, while moderately resistant and highly resistant lines showed a proportional decrease in percent of infection, some lines having no virus X present. Although numbers of infected plants within given lines were not consistent from year to year, percentages between lines were essentially similar.

In general, stocks from growers showed a similar trend when indexed after a 3 year period. Some highly resistant lines contained no virus X infected plants. Several varieties under production for 6 years contained a very small percent of infected tubers.

It is possible for virus X-free seed potatoes to be grown under commercial conditions in this country. However, it is likely that such stocks must possess a high degree of field resistance before this method will become practical.

BISHOP, GUY W.

TRANSPLANTS AS A SOURCE OF THE GREEN PEACH APHID, *MYZUS PERSICAE* (SULZ) IN THE POTATO SEED PRODUCING AREAS OF IDAHO

The green peach aphid,*Myzus persicae* (Sulz) has been found to be the important vector of potato leafroll in the certified seed producing areas of Idaho. These areas are located at high elevations and are well isolated from known concentrations of winter hosts of this aphid. Investigations during 1958 showed the green peach aphid to be entering the potato seed producing areas on transplants used in home gardens and on cut flowers. Subsequent investigations on the distribution of the green peach aphid and the distribution of potato leafroll infections indicate that these are the major sources for the green peach aphid infestations that occur in certified potato seed fields.

BRING, SHIRLEY V., CAROL GRASSL, MILES WILLARD, AND JOYCE T. HOFSTRAND

THE VITAMIN C CONTENT OF RAW POTATOES, FRESH MASHED POTATOES, AND RECONSTITUTED DEHYDRATED FLAKES

The vitamin C and moisture contents of raw potatoes, fresh mashed potatoes, and reconstituted dehydrated flakes were determined in October, February, and May or near the beginning, middle, and end of the processing season at an Idaho processing plant. Samples were drawn periodically from the raw and flake lines. The flake samples were drawn after the procsesing time interval so that the flake and raw samples represented the same lot of potatoes. Part of the raw sample was cooked and mashed by a standardized method. The flakes were reconstituted with distilled water (no milk) according to directions printed on the consumer package. Vitamin C determinations were made by the Roe and Oesterling method[1]. Moisture content was determined by drying the samples under vacuum at approximately 50 C.

The average vitamin C content of the raw potatoes sampled in October, February, and May was 29.34 ± 0.72, 11.72 ± 0.23, and 10.58 ± 0.19 mg/100 g of sample, respectively. Each period, the fresh mashed potatoes contained approximately two-thirds as much vitamin C as the raw potatoes. However, the reconstituted flakes contained only approximately one-fourth as much as the raw or approximately two-fifths as much as the fresh mashed potatoes. The per cent losses of vitamin C from October to May were essentially the same for each of the three products: 63.72 to 65.37%.

[1]Roe, J. H., and M. J. Oesterling. 1944. The determination of dehydro-ascorbic acid and ascorbic acid in plant tissues by the 2,4-dinitrophenyl-hydrazine method. J. Biol. Sci. 152: 511.

DIONNE, L. A.

THE USE OF *SOLANUM ACAULE* AS A BRIDGE BETWEEN THE MEXICAN STELLATE FLOWERED SPECIES AND THE TUBEROSA

Solanum acaule was shown to be crossable with *Solanum bulbocastanum* and *S. pinnatisectum*. The full resistance to *Phytophthora infestans* of *S. bulbocastanum* was transmitted to the hybrids of that species with *S. acaule*. The F_1 *hybrids* were triploids and sterile as expected. However, the colchicine induced hexaploids are fertile and crossable with other species. These hybrids are now being used to transfer the disease resistance of these previously isolated Mexican species to *Solanum tuberosum*.

DRIVER, C. M.

BREEDING FOR RESISTANCE TO DISEASES AND PESTS

Plant breeders have been unsuccessful in the past wherever they have used a hypersensitive type of reaction to disease as the basis for resistance. This resistance breaks down with the arrival of new races which are shown to result from deleterious or adaptive mutations and not from beneficial ones. As there is no practical limit to the number of deleterious mutants possible, permanent resistance connot come from hypersensitivity alone. Field resistance is the expression of an evolutionary balance between organism and plant needing a beneficial mutation to break it down. As all the evidence indicates field resistance does not break down, it would appear that

fungi obey the orthodox genetic laws, i.e. beneficial mutations are rare. Breeding for field resistance is thus considered to hold great promise.

Lack of success in the development of permanently effective insecticides can be ascribed to wrong methods of testing. Testing insecticides against the most resistant section of the population should result in better insecticides.

HOUGHLAND, G. V. C., R. V. AKELEY, AND A. E. KEHR

A PROGRAM FOR BREEDING INDUSTRIAL POTATO VARIETIES

As developments in potato processing continue, the supplies of potatoes available for industrial uses tend to decrease. At the same time demands for potato starch and flour are increasing, thus creating a need for industrial potato varieties.

New work in the potato-breeding program of the U. S. Department of Agriculture was initiated in 1959 for producing suitable industrial varieties. Starch analyses and dry-matter determinations, germination of seed in sucrose solutions, and field selection of plants capable of maximum radiant absorption by virtue of their "open" type vine growth, corrugated leaflets, and pupbescence all are being employed. Promising seedling are being increased and field tested for economic production of starch per acre under intensive cultural conditions.

HOYMAN, WILLIAM G.

SOME PATHOLOGICAL AND HORTICULTURAL CHARACTERISTICS OF KENNEBEC AND GOLDEN CHIP POTATOES

Because vines and tubers of Kennebec and Golden Chip potatoes appear similar, plants of each variety, along with a susceptible check variety, were inoculated with 8 races of *Phytophthora infestans*, 1 strain of virus A, 2 strains of virus Y, and 4 strains of virus X, to determine whether their pathological reactions were similar. All Kennebec and Golden Chip plants were known to be free of viruses A, X, and Y before inoculation. All late-blight inoculations were made from 12-day-old cultures growing on potato-dextrose agar. *P. infestans* races 1,2,3,4; 1,2,4; 1,3,4; and 1,4 were pathogenic on both varieties and the susceptible check variety. Races 0; 1,2,3; 2,3,4; and 2,4 were not pathogenic to Kennebec or Golden Chip but infected the susceptible check variety.

The reactions of plants inoculated with viruses A, X, and Y were determined at 60 to 65 F and 75 to 80 F. Both Kennebec and Goden Chip were susceptible to these viruses and the symptoms expressed appeared similar. Field observations have indicated both are susceptible to the leaf-roll virus.

Kennebec and Golden Chip were grown at 2 locations in the Columbia Basin and at Mt. Vernon, Washington and the specific gravities of the two were identical at one location and differed by .002 and .007, respectively, at the other two. The chip-color ratings obtained from chipping tubers stored at 38 F. and conditioned for 3 different periods were identical. Other characteristics which appeared similar were the rapid development of chlorophyll in the skin of the tubers, the breaking of dormancy, and the flower shapes and colors.

HRUSCHKA, H. W.

"STEREO-PLOTTER" FOR THREE-DIMENSIONAL GRAPHS

The "Stereo-Plotter" is a mounted set of individually adjustable square rods for making and photographing three-dimensional bar graphs rapidly and inexpensively. Different rod heights, colors, or surface-designs show differences graphically. Numbers and "Duncan-Test" letters on rods show actual and statistical differences. The 3-D graph on the "Stereo-Plotter" can be photographed from several angles by various techniques. Certain optical illusions and drawing problems are eliminated. Data, colors, and surface designs can be arranged for comparison, studied, rearranged and edited either before or after photographing. More critical choice, and better quality published graphs can result. Especially suited are data from horticultural studies involving measurements of time, temperature, decay; variety, treatment, yield; and humidity, temperature, weight-loss. Data lines which run close or are superimposed when drawn as two-dimensional line graphs are better shown in 3-D. Data from other research fields are also suited for graphing by the "Stereo-Plotter".

HRUSCHKA, H. W., R. V. AKELEY, E. H. RALPH, R. L. SAWYER, A. H. SCHARK

SEED POTATO PRODUCTIVITY AFTER COOLING, SUPERCOOLING OR FREEZING

This study was made to determine the seed value of non-frozen potatoes from freight cars or trucks in which part of the load was frozen. Previous reports have been contradictory. Therefore, certified seed grown in Maine or North Dakota were stored and treated at Beltsville, Maryland, and planted in split split-plot tests in Delaware, New York and Maine. Seed of 4 varieties were tested with 5 temperature treatments in 4 replications. Seed were planted whole or immediately after cutting. All potatoes were stored at 40 F before temperature treatment, and were held for sprouting at 50 F for 2 weeks after treatment. Treatments were i) 40 F continuously (checks), ii) 30 F one day, iii) 30 F ten days, iv) 25 F one day (supercooleded without freezing) and v) 25 F one day with freezing symptoms produced. Unless freezing (with visible symptoms) occurred in the seed tubers, freezing or near-freezing temperatures did not adversely affect emergence, growth and yields. Cold treatment sometimes increased yields slightly.

JOHANSEN, R. H.

CHIPPING TESTS OF SEVERAL POTATO VARIETIES AND SELECTIONS GROWN IN NORTH DAKOTA

From 1957 through 1959, chipping quality tests were conducted on severeal potato varieties and selections grown in North Dakota.

These varieties and selections tested for chip color and yield were grown in replicated variety trials at Grand Forks, Park River and Williston, North Dakota. The trials at Williston consisted of potatoes grown under irrigation and non-irrigation. Samples chipped were stored at reconditioning temperature of 70 F and chipped at intevals of one or two weeks for approximately two months. Environmental conditions such as tempereature and rainfall affected chip quality during certain years. The varieties Irish Cobbler and Kennebec and the selection ND3324-2 (Snowflake) generally produced light colored chips after reconditioning for four weeks. The variety Irish Cobbler and the selections ND3324-2 (Snowflake), ND4122-2 and ND3676-20 produced the highest chip yield. At Williston, the varieties and selection grown under non-irrigation generally produced chips of lighter color and higher chip yield than those grown under irrigation. The varieties Kennebec, Norland and Irish Cobbler and the selection ND3324-2 (Snowflake) grown under non-irrigation produced light colored salable chips after four weeks reconditionnig. In the irrigated trial, Kennebec and Irish Cobbler produced chips of light color after four weeks reconditioning, while Norland and ND3324-2 (Snowflake) had to be reconditioned six weeks to achieve good salable color. In both the irrigated and non-irrigated trials, Nordak and Norgleam generally produced chips of dark, unsalable color.

KNUTSON, KENNETH W. AND CARL J. EIDE

A COMPARISON OF GREENHOUSE AND FIELD GROWN POTATO PLANTS IN REGARD TO LATE BLIGHT INFECTION

Field grown plants of the potato varieties Cobbler, Pontiac, and Sebago were found to be more susceptible, as evidenced by more and larger lesions, to infection by race 0 of *Phytophthora infestans* than greenhouse grown plants of the same varieties.

Cobbler variety potato plants grown under 3 differeent regimes (greenhouse grown; field grown for 25 days, then transplanted to the greenhouse 3 weeks before inoculation; and field grown plants) were inoculated by placing filter paper discs, dipped in a sporangial suspension of *P. infestans* on the leaves. After incubation in a moist chamber for 26 hours the plants were placed on a greenhouse bench. Three days after inoculation the lesions on field grown plants were 4-5 times larger than lesions on greenhouse grown plants. Lesions on the field-grown plants kept in the greenhouse for 3 weeks were intermediate between the other two. Six days after inoculation the leaves on field grown plants were nearly dead while the leaves on greenhouse grown plants were still intact although the lesions had enlarged somewhat. Cobbler plants from the 3 regimes mentioned above were also spray inoculated with

a sporangial suspension containing 20,000 sporangia/cc. Field grown plants had 2-3 times more lesions which were several times larger than on greenhouse grown plants.

Field and greenhouse grown plants of the varieties Pontiac and Sebago were also spray inoculated with a sporangial suspension containing 20,000 sporangia/cc. Here again, field grown plants were much more susceptible than greenhouse grown plants.

KRUM, J. K.

NEW APPLICATIONS OF FUSAREX TO STORED POTATOES

Concern for quality maintenance of stored potatoes and the need for a versatile sprout inhibitor led to the experimentation and development of several new methods of application of Fusarex (tetrachloronitrobenzene). Although tetrachloronitrobenzene has been used for many years in the form of a dust on potatoes going into storage, economically today's storage of potatoes does not permit only one method of treatment at only one time of the year. Such applications as sublimation, blowable dusts, aerosols, liquid sprays, are described and results to date discussed. Additional information is presented on the application of Fusarex to seed potatoes and its efficacy in controlling dry rot in stored potatoes.

KUNKEL, R.

A SIMPLIFIED BELT ATTACHMENT FOR IRON AGE POTATO PLANTERS FOR APPLYING SMALL QUANTITIES OF FERTILIZER, ETC.

The unifom application of experimental quantities of fertilizer materials is easily accomplished by broad rotating belts. These attachments, however, frequently necessitate removal of the planter fertilizer hoppers, extension of the planter tongue, and otherwise interferes with short turning. To overcome these objections, two independent attachments were built and each mounted with a double set of bearings to make it possible to raise the attachments away from the tractor wheel to facilitate turning.

KUNKEL, R., M. W. CARSTENS, W. G. HOYMAN AND N. SANDAR

POTATO VARIETIES AND THEIR SUSCEPTIBILITY TO BLACKSPOT WHEN BRUISED

With the hope of finding genetic material which was either very susceptible or very resistant to blackspot when bruised, some seventy varieties and promising selections of potatoes were grown for two years at Mount Vernon and at two locations in the Columbia Basin of Washington. None of these varieties developed enough blackspot when bruised to constitute a commercial problem. The varieties grown in the Columbia Basin were tested shortly after harvest. Those grown at Mount Vernon were tested after about five months in storage at 40 F in 1959 and shortly after harvest in 1960.

KUNKEL, R., AND A. I. DOW

A POSSIBLE FUNCTION OF POTASSIUM IN DECREASING SUSCEPTIBILITY OF RUSSET BURBANK POTATOES TO BLACKSPOT WHEN BRUISED

Applications of potassium in the fertilizer generally have resulted in a reduction in the severity of blackspot, but even relatively large applications have failed to eliminate blackspot as a problem. On a soil extremely low in potassium, as determineed by soil and tissue analysis and yield response to applications of potassium, 300 pounds per acre of K_2O reduced the blackspot index about 30%. Hydrating in the laboratory samples of tubers from soils extremely deficient in potash caused them to be almost completely resistant to blackspot when bruised twenty-four hours later. Careful washing out of the root systems on soils of high and low potassium content showed the root systems on the low-potash soils to be small and have relatively few root hairs. Dehydration in sucrose solution of cores of tissue cut frm tubers grown on high-potash soils showed the cores cut from tubers grown on potash-deficient soils to discolor sooner and to reach a darker final color than those cut from tubers grown on a high-potash soil. It would then appear that potash functions, at least

in part, by making it possible for a plant to more effectively absorb water from the soil, and by making the tissue less susceptible to desiccation.

KUNKEL, R., AND A. I. DOW

FERTILIZERS AND THE CONTROL OF BLACKSPOT IN WASHINGTON

Studies of the effects of nitrogen, phosphprus and potash on susceptibility to blackspot have been conducted for the past four years. On soils testing high in phosphorus and potash, increasing the rates of application of nitrogen from 80 to 240 pounds per acre has in general decreased the severity of blackspot, with a corresponding decrease in specific gravity. Phosphorus generally has been without effect, but on a soil extremely deficient in phosphorus, increasing phosphorus increased the vegetative gowth and increased the blackspot. Increasing potash in the fertilizer from none to 400 pounds per acre of K_2O decreased the blackspot about the same as did the rates of nitrogen used, and with corresponding decreases in specific gravity. Potassium from muriate of potash and from sulfate of potash gave similar results..

KUNKEL, R. AND W. H. GARDNER

MOISTURE STRESS AND THE DEVELOPMENT OF BLACKSPOT IN RUSSET BURBANK POTATOES WHEN BRUISED FOLLOWING ROOT PRUNING

Tubers and root systems of potato plants growing on wet and dry soils were carefully uncovered, and all of the roots except three or four on the bottoms of the stems were cut off with a sharp knife. The tubers were then covered with soil. During late afternoon ,about eighteen hours later, the plants with pruned roots on the dry soil showed definite wilting. The tubers again were uncovered and bruised by dropping a 100 gram plug with a hemispherical end two feet through a plastic tube, while the tubers were still attached to the plants. About fifteen hours later, when the tubers again were uncovered and the bruised spots peeled, those tubers on plants in the dry soil showed large chocolate brown spots, whereas the spots on those growing in the wet soil were scarcely observable.

KUNKEL, R. AND N. SANDAR

THE W.S.U. PRESS-WHEEL POTATO PLANTER

The principle of deep planting and shallow covering of potato seed pieces to reduce Rhizoctonia damage by causing a quicker emergence is not new. To accomplish this objecetive, various methods have been tried over the past three years in Washington. Of the methods tried, only rolling the ridges immediately behind the planter proved feasible, and would accomplish a second objective which was to compact the soil about the seed piece to reduce soil porosity and thereby increase the movement of water from the irrigation furrow into the center of the ridge.

A set of covering rollers was developed to replace the conventional covering discs on a potato planter. Some of the benefits which resulted from roller covering of the seed as a result of one year's work were a quicker emergence, better stands, easier weed control, larger yield and a higher percentage of number one potatoes.

LARSEN, FENTON E.

EXTERNAL AND INTERNAL (BLACKSPOT) MECHANICAL INJURY OF WASHINGTON RUSSET BURBANK POTATOES FROM FIELD TO TERMINAL MARKET

Mechanical injury studies were initiated to determine the primary source of injury of Russet Burbank potatoes, as they are usually handled in Washington—from field to grader to market .

In 1960, samples were collected from several areas of the Columbia Basin over a two-month period to evaluate injury from harvesting and grading. Ten tons of potatoes from 17 growers and 9 shippers were evaluated. External injury was rated as none, blemished, slight, moderate, and serious with corresponding paring wastes from none to 10% or over. Blackspot was evaluated by peeling sub-samples and rating each spot on a 1-10 scale; the number of spots per tuber and the percent of the sample affected were recorded.

Seventy-eight per cent of the potatoes having external injuries were injured during harvest. Grading and preparation for market more than doubled slight and moderate injury over that contributed by harvesting, but serious injury was increased very little.

Seventy-eight per cent of the tubers injured by blackspot were injured during harvest. Grading nearly doubled the number of spots per sample, but did not appreciably effect the spot intensity.

Shipping injury was estimated on each of 3 cars shipped from Washington to Chicago. Pre-shipping injury was determined from a 5% sample extracted at loading time. An 11% sample was scored at destination for post-shipping injury. A good estimate of external inury was not obtained. An increase in blackspot similar to that caused by grading was noted.

LOGSDON, CHARLES E. AND HAROLD STEPHAN

WEIGHT LOSS IN SOME ALASKAN POTATOES FOLLOWING VARIOUS PRESTORAGE TREATMENTS

Eighty-three days were required for Green Mountain potatoes to reach an equilibrium in weight loss when taken directly from the field and placed in storage at 38 F. The time necessary to reach equilibrium and the slope of the weight-loss curve were reduced by prestorage treatment. A minimum of 70 F. for 14 days was necessary to effect these changes. The most effective treatment was 70 F. for 14 days following a curing period in exceses of 14 days at high humidity at better than 50 F.

The slope of the weight-loss curve after equilibrium was reached depended on both the prestorage treatment and variety. Ontario was found to lose weight at approximately double the rate that Green Mountain lost.

The most effective treatments were those made prior to the end of the rest period. Green Mountain was found to be through its rest period by the time equilibrium in weight loss was established.

MURPHY, H. J. AND M. J. GOVEN

NITROGEN FERTILIZATION OF THE KATAHDIN, SACO, AND PLYMOUTH VARIETIES IN MAINE

In Maine, where potatoes may be grown for either fresh market, seed purposes processing, or industrial use, manipulation of rate of fertilizer nitrogen is a very critical problem.

Data from Maine reveal that high rates of nitrogen do not always produce high yields of tubers, are detrimental to quality, and reduce percentage of marketable product. It would also appear that recommendations for fertilizer nitrogen could vary from 100 to 180 pounds per acre even within restricted climatic areas depending on the proposed use of the tubers and variety grown.

MURPHY, H. J. AND M. J. GOVEN

SIMULATED HAIL DAMAGE TO POTATOES IN MAINE

Potato production in Maine is a highly specialized industry with tremendous investments in land, equipment, and production costs. To safeguard these valuable investments, most growers insure their potato crop against hail damage.

Without quantitative information on the effect of hail damage on yield, quality and grade size distribution of tubers grown under Maine climatic conditions, insurance adjusters have found it difficult to make settlements that were fair to both the insurance underwriters and the potato growers.

Studies conducted in Maine over the period of 1956 to 1960 would indicate that yield reductions due to hail damage of potato foliage varies with stage of vegetative growth and intensity of hail damage. In most years, simulated hail caused the most damage when it was applied around full bloom stage of vegetative growth.

PELOQUIN, S. J., L. R. MORTENSON AND R. W. HOUGAS

GERMINATION OF SOLANUM POLLEN ON ARTIFICIAL MEDIA

Pollen of 18 tuber-bearing *Solanum* species representing 10 taxonomic series was germinated on artificial media. Both the percentage of germination and extent of pollen tube growth were greatly affected by small quantities of boron. Three hours

after placing pollen in 20% sucrose plus 50 ppm boric acid, 40 to 80% of the grains germinated and pollen tubes were 100-300 microns long. In 20% sucrose without boron, usually less than 1% of the pollen germinated and the pollen tubes were rarely longer than the diameter of the pollen grains. Pollen of 2 species did not germinate on either medium. The percentage of "stainable" polllen was usually from 5 to 30% higher than the percentage of germination.

SAWYER, R. L.

EFFECT OF PLANTING DATES, FERTILIZATION AND SPACING ON YIELD, STORAGE QUALITY AND CHIPPING QUALITY OF KENNEBEC AND KATAHDIN VARIETIES ON LONG SLAND

There was a considerable interaction among planting dates, amount of nitrogen and spacing with both Katahdin and Kennebec varieties on yield and storage quality.

The overall results of several years indicate 8-inch spacing to be best for good consumer pack with Katahdins.

The earlier the planting, the better was the yield, the higher the specific gravity and the earlier the sprouting in storage. At the early April planting, yields tended to increase as nitrogen was increased from 140 to 200 pounds per acre. As nitrogen was increased above 140 to 175 pounds per acre, yield was decreased in May plantings. There was a tendency for specific gravity to decrease as nitrogen was increased above 170 pounds. However, this was most pronounced in late plantings.

Blackspot was considerably reduced by delaying planting past the first week in May. Chipping color was definitely affected by planting dates. The type of growing season determined whether early or late plantings gave best quality.

With Kennebec variety, best total yield of U. S. No. 1's tended to be with an 8-inch spacing. However, best yield in the 2 to 3½" size was with the 6-inch spacing. The earlier the planting date, the better was the yield and the earlier sprouting occurred in storage. Specific gravity tended to be best at the early May planting. At the early April planting, yield tended to increase as nitrogen was increased from 140 to 200 pounds per acre. At the June 1 planting, yield decreased as nitrogen was increased above 140 pounds. Specific gravity decreased as nitrogen was increased over 140 pounds per acre. However, as with Katahdin variety, this was most pronounced at the late planting dates. Both blackspot and chipping color were affected by planting date. The type of season determined whether early or late plantings gave best quality.

SAWYER, R. L. AND R. CETAS

YIELD VARIABILITY AMONG KATAHDIN SEED SOURCES

A variation in productivity which cannot be identified by the certification tag exists among Katahdin seed sources. Seed grown as a late crop on Long Island consistently yielded as good as the best Maine sources, despite a high incidence of virus X and leaf roll in Long Island grown seed. Long Island grown seed was very immature as a result of planting in late July and early August.

Although there was no complete relationship of virus X to yield with Maine seed sources, there was an indication that high levels of virus X reduced yields.

The results indicate considerable area for progress in production of good seed with a consistent high yielding ability. Some of the variability obtained was due to virus X and some appears due to cultural and storage practices used in production of the seed crop.

SAWYER, R. L. AND W. H. THORNE

FURTHER WORK IN THE ALCOHOLS FOR SPROUT INHIBITION

A single treatment with a decyl alcohol gave good sprout control for a five-month period in 400-bushel experimental bins. Excellent control of shrinkage, firmness and blackspot was also observed.

No persistence of alcohol fumes was detected with washed or unwashed potatoes after five days upon removal of the tubers from storage and packaging in several types of consumer 10-pound packages. There was considerable yearly variability in the effect of the alcohols on the treated potatoes used for seed. Katahdin variety appeared more sensitive than Kennebec to sprout control with the alcohols.

Both Katahdin and Kennebec varieties treated with a decyl alcohol and held at temperatures which would allow sugars to accumulate, cured out very well in a three-week period.

SPARKS, WALTER C.

AIRFLOW AND ITS EFFECT ON SPROUTING AND STORAGE LOSSES OF RUSSET BURBANK POTATOES

Twenty-eight bins representing 4 replications of seven different amounts of airflow treatments were placed in the new Potato Storage Research Building. All 28 bins received exactly the same air in relation to temperature and humidity. Each bin had its own separate thermostatic arrangement for air control. Each bin held approximately 2 tons of potatoes with the air being delivered at the bottom of the bin and blown out at the top. The results indicate that there is a tremendous difference in the number of sprouts formed in bins receiving the various air flows. The no air flow treatments had very numerous sprouts and had rootlets at the nodes. The bins which received 1.25 cfm/T had very long sprouts and the sprouts had many roots at the nodes. The 2.5 cfm/T air flow treatments had fairly long sprouts but had no rootlets at the nodes and only a few rootlets at the base of the sprouts where the sprouts joined the tuber. The 5 cfm/T treatment had very much shortened sprouts and no hair roots. The 10, 20, and 40 cfm/T treatments had very few to no sprouts and no rootlets. The rootlets caused the tubers to be bound together and required removal almost tuber by tuber, whereas those with no rootlets and few sprouts were very easy to remove from the storage bins. As the amount of air flow through the mass of potatoes increased, the amount of sprouts decreased, whereas as the amount of air going through the mass increased, the amount of loss by dehydration increased by a slight amount.

SMITH, ORA AND C. O. DAVIS

PREVENTION OF GRAYING IN DEHYDRATED POTATO PRODUCTS

Quality control of potato flake color is possible with the use of sodium acid pyrophosphate (SAPP). It may be applied in the first cooking as a 1.5-2.0% solution or in the second stage cooling procedure prior to steaming. Addition of SAPP with the additives may also be used but the results are too variable for commercial recommendation. Some plants may use a combination of both points of application.

Flakes may be treated when removed from the drier, when packaged, or when reconstituted. Incorporation of the SAPP in finished products may be done using a mist spray and a quick redrying with supplemental heat prior to packaging. This will avoid the sloughing of adhering particles of SAPP which would occur when it is added as a powder to the finished product.

Addition of 1-3 ml of 2% SAPP to 50 grams of reconstituted flakes or granules makes the finished products much whiter, increasing the Agtron reflectance reading from 40 to 100. Treating potatoes prior to drying is best since the chance of too acidic a product is virtually eliminated when a refractometer is used to maintain the desired solution concentration.

Potato slices to be dehydrated may be treated with a solution of 2% SAPP plus 0.3% $NaHSO_3$ for 1-2 minutes at 100-180 F depending on the potatoes and severity of discoloration. This may be done in the initial blanching; better results, however, are attained if the treatment follows the initial blanch.

Potatoes used for salad usually are boiled with the skins attached and then peeled after cooling. A 2-3 minute dip of the boiled potatoes in a 2% SAPP solution reverses the discoloration of these peeled potatoes restoring them to a bright white color. Addition of a small amount of a 2% SAPP solution to the salad as it is being mixed results in a bright creamy product rather than one of a grayish cast.

TIMM, HERMAN AND JERRY RIEKELS

EFFECT OF LEVELS OF PHOSPHORUS AND SOURCE OF NITROGEN UPON POTATO PLANT GROWTH, LEAF TISSUE COMPOSITION, AND TUBER YIELD

Data obtained by growing White Rose potatoes in an organic soil from the Copic Bay area of Tulelake in North-eastern California, indicated anion compe-

tition was a factor in phosphorus uptake. Three levels of phosphorus, O 120, and 240 pounds per acre applied as $Ca(H_2PO_4)_2.H_2O$, with three sources of nitrogen, as $(NH_4)_2SO_4$, NH_4Cl and NH_4NO_3 added to give 120 pounds per acre of N, were studied under greenhouse growing conditions. Foliage fresh weight as well as tuber yields were significantly lower with NH_4Cl at all levels of phosphorus as compared with other sources of nitrogen. Analysis of leaf tissue revealed that the phosphorus content was significantly lower with the presence of Cl— as compared with NO_3—SO_4= ions with all levels of phosphorus treatment. No marked differences in the nitrate-nitrogen content was found due to treatment.. Tuber yields were significantly increased with each increment of phosphorus which supported earlier field trial evidence that this particular soil was deficient in available phosphorus..

ZAEHRINGER, MARY V., H. H. CUNNINGHAM, D. J. LETOURNEAU AND J. T. HOFSTRAND

OBSERVATIONS ON THE FIRMING OF POTATO TISSUE SLICES ON SOAKING IN DISTILLED WATER

Soaking 100 g of thin slices of potato tissue in 250 ml of distilled water for 1, 2, or 3 hours resulted in a several-fold increase in cooked potato weight (CPW) over that of the unsoaked tissue. After a 2-hour soak, the raw slices had lost about 1% total solids and had gained about 12% in weight. The CPW of cooked soaked tissue increased up to 300% in weight over that of cooked unsoaked tissue. The CWP increased as the temperature (7-57 C) at which the potatoes were soaked increased.

Results indicated that the increase in CPW was due to leaching of some constituent(s) from the tuber slices. To test this hypothesis 100 g of slices were soaked in 250 ml of distilled water. Both soaked and unsoaked tissue slices were then cooked in varying proportions of soak water/distilled water. The CPW of both soaked and unsoaked tissue decreased as the amount of soak water was increased, but the decrease in CPW was much greater with the soaked tissue. Increasing the amount of surface area exposed during soaking by varying the size of the pieces of tissue, increased the effectiveness of the soak water in reversing the firming. Soak water from potatoes of specific gravity 1.095-1.098 had a greater softening effect than that from tubers of specific gravity 1.075-1.078. Preliminary assay of soak water indicated that the amount of potassium in the soak water increased with the soaking time. Studies of the effect of selected potassium salts on CPW are currently underway.

ZAEHRINGER, MARY V., H. H. CUNNINGHAM, D. J. LETOURNEAU AND J. T. HOFSTRAND

STANDARDIZATION AND REFINEMENT STUDIES OF AN OBJECTIVE COOKING METHOD FOR EVALUATING TEXTURE OF POTATOES

One-hundred-gram samples of thin tissue slices (8 x 8 x 1.3 mm) from potato tubers were cooked in 1200 ml of distilled water in a 2-liter stainless steel beaker in duplicate. To accentuate sloughing losses the mixture was mechanically agitated during boiling with a 3-blade metal propellor 5 cm in diameter placed 2.5 cm above the bottom of the beaker and rotating at 1000 rpm. Following the cooking period (15 to 25 min.) the sample was poured onto a No. 10 screen, rinsed in distilled water, and allowed to drain. The weight of the cooked potato (CPW) was used as the index of texture.

Standardization studies showed that: i) CPW was inversely related to specific gravity; ii) the potatoes gained in weight during the first 10 minutes of cooking but decreased after 15 minutes; iii) CPW was directly correlated with the distance of the propellor from the edge of the beaker; iv) cooking temperatures greater than 97 C resulted in the formation of a foam cap and a decrease in CPW. Use of an anti-foam agent eliminated this source of variation. v) The length of the cooking period selected denends on the particular sample and type of experiment; vi) the average difference between duplicate determinations on the same sample was 3 g; and vii) allowing the tissue slices to stand in distilled water before cooking caused significant increases in CPW. No significant effects on CPW were observed from: i) Varying the distance of the propellor from 1.9 to 3.8 cm from the bottom of the beaker; and ii) allowing the potato slices to stand under a damp towel for periods up to 3 hours.

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RUSSELL H. LARSON, 1904-1961

Russell H. Larson, an honorary life member of the Potato Association of America and professor of Plant Pathology at the University of Wisconsin, died on August 29, 1961 after a long illness.

Dr. Larson graduated from Ripon College in 1928 and won his Masters and Ph.D. degrees at the University of Wisconsin and was appointed to the staff of the Plant Pathology Department there in 1934 upon winning his Ph.D.

He was also affiliated with the U. S. Department of Agriculture as pathologist. He studied in England, Scotland and Ireland in 1946 and in 1954 was a Fulbright Fellow in potato virology at the University of Wageningen, Holland.

Professor Larson was widely known for his studies of the host-parasite relations of the Crucifer Clubroot organism, improvement of methods and for the development of disease resistant varieties of vegetables. His research papers on numerous virus diseases of potato were outstanding and highly regarded internationally.

He was an outstanding teacher and many graduate students came from foreign countries to study under him. His work on the diseases of potato gave him an international reputation and was responsible for his election to honorary life membership in the Potato Association of America.

He is survived by his wife Margaret Hart, his parents Mr. and Mrs. William Larson and a brother Melvin.

Our sincere sympathy is extended to his family.

GUSTAV H. RIEMAN, 1902-1961

Gustav H. Rieman, who was elected to honorary life membership in the Potato Association of America at the Annual Meeting in Wenatchee, Washington, died October 8, in Rhinelander, Wisconsin of a heart attack. Dr. Rieman suffered a heart attack on September 27 while harvesting potatoes at the University of Wisconsin potato breeding plots near Rhinelander and was taken to the Rhinelander hospital. He was professor of Genetics at the University specializing in potato breeding and disease problems. He was a very active member of the Potato Association of America and served as its President in 1952.

Dr. Rieman, in cooperation with other scientists at the University, developed the Russet Sebago variety in the 1940's and the Red Beauty and Antigo varieties in the 1950's. Earlier this year he had announced the development of the Superior variety.

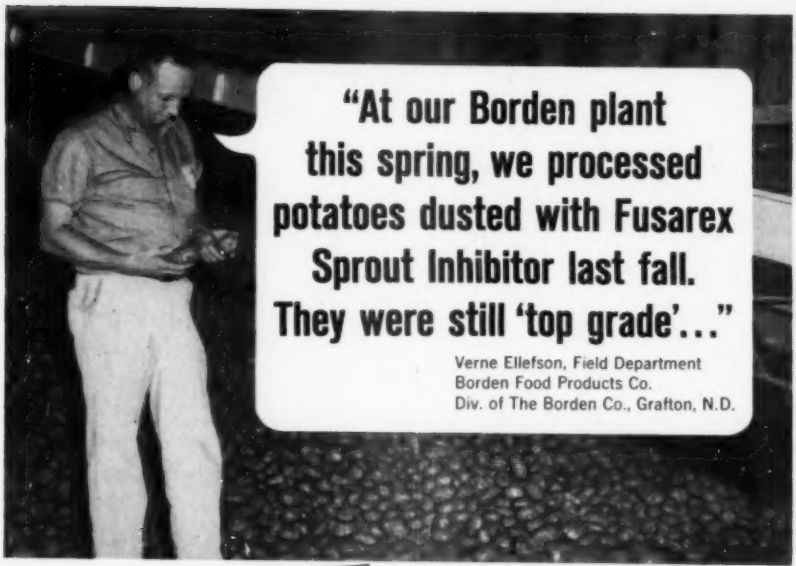
Professor Rieman was instrumental in starting the Wisconsin state foundation seed farm where highest quality seed potatoes are grown for the state's seed potato growers.

He was born in Nerstrand, Minnesota and graduated from Iowa State University in 1925. He earned the Masters and Ph.D. degrees at the University of Wisconsin and had been associated with the University since 1936.

He was a member of Sigma Xi, the American Association for Advancement of Science and was a member of the Congregational Church.

"Gus" as he was called by his many friends, will be greatly missed by his associates.

Our deep sympathy goes out to his wife and family.



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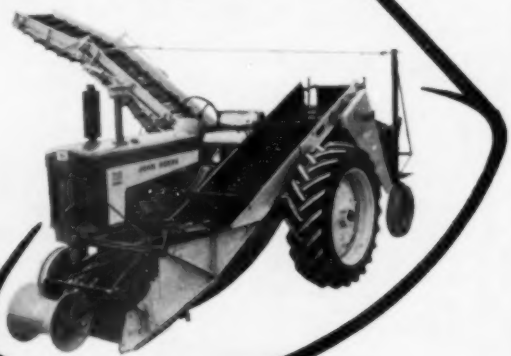

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